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The selective wavelength filtering characteristics of Tokai optical medical lenses and a discussion of current applications in the clinical setting.

David Dowe
Pacific University

Weon Jun
Pacific University

James Phelan
Pacific University

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Abstract

Tokai Optical Company in Okazki, Japan, has developed a new line of CR-39 medical lenses designed to manage certain ocular and visual disorders. Before these lenses can be incorporated into the medical market, it is necessary to verify the selective filtration characteristics claimed by Tokai Optical Company. Using a modified Varian OMS 200 UV/Visible Spectrophotometer, Tokai Optical 'CC Filter' lenses were analyzed and compared to the transmission properities published by the manufacturer. It was concluded that the spectral transmission results differ by no more than 3.5 percent transmittance with the majority being less than 1.0 percent difference. The historical use of spectrally selective lenses in the treatment, management and prevention of ocular and visual disorders is also discussed.

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THE SELECTIVE WAVELENGTH FILTERING CHARACTERISTICS OF TOKAI OPTICAL MEDICAL LENSES AND A DISCUSSION OF CURRENT APPLICATIONS IN THE CLINICAL SETTING.

By:

David Dowe

Weon Jun

James Phelan

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Adviser:

Willard B. Bleything, O.D., M.S.

Authors

David Dowe

Weon Jun

James Phelan

Advisor:

Willard B. Bleything O.D., M.S.

About the Authors

David Dowe was raised in Nanaimo, British Columbia, a small city on the east coast of beautiful Vancouver Island. After receiving his Bachelors of Science degree from the University of Victoria, he traveled to Guyana, South America where he participated on several medical and scientific missions into the remote South American interior. It was here that he decided, upon his return, to pursue a career in optometry. David recently completed his optometric preceptorship at Tyndall Air Force Base, Florida and plans to practice optometry in British Columbia after graduation.

Weon Jun was born in Jinju, Korea and moved to Fairbanks, Alaska in 1981. He completed his Visual Science degree at Pacific University and entered the Optometry School in 1991. Weon completed his preceptorship at the Eye Foundation of Utah. One of the most rewarding experiences in optometry school was being the president of AMIGOS and participating in eye care missions locally and internationally. He has been selected for the 1994 Dean's Award and was nominated for Who's Who Among Students in American Universities and Colleges. His future plans are to complete a residency program and practice in Oregon or Washington. He also plans to continue to support AMIGOS.

James Phelan is currently doing a preceptorship at Malmstrom Air Force Base in Great Falls, Montana. Raised in Helena, Montana, he studied Pre-Med., with a minor in chemistry at Carroll College. James was awarded the Thomas Sullivan Memorial Scholarship for Academic Achievement in Biology. He then shifted his focus from medical school to optometry school, choosing Pacific University because of its reputation and its ideal location. During his second year as an optometry student, James was awarded the Montana Optometric Association Scholarship for academic leadership and community involvement. James is planning to settle in Great Falls, Montana when he graduates in May.

Abstract

Tokai Optical Company in Okazki, Japan, has developed a new line of CR-39 medical lenses designed to manage certain ocular and visual disorders. Before these lenses can be incorporated into the medical market, it is necessary to verify the selective filtration characteristics claimed by Tokai Optical Company. Using a modified Varian DMS 200 UV/Visible Spectrophotometer, Tokai Optical 'CC Filter' lenses were analyzed and compared to the transmission properities published by the manufacturer. It was concluded that the spectral transmission results differ by no more than 3.5 percent transmittance with the majority being less than 1.0 percent difference. The historical use of spectrally selective lenses in the treatment, management and prevention of ocular and visual disorders is also discussed.

Introduction

It is well known that illumination plays a crucial role in optimizing useful vision in patients with reduced visual function resulting from disease or the aging process. For this reason, practitioners prescribe neutral density or selective filtration (S.F.) lenses in an attempt to increase patient comfort and visual performance. It has also been proposed that by selectively filtering specific wavelengths from entering the eye, destructive pathological processes may be slowed.

Tokai Optical Company has developed a series of lenses specifically with this in mind. The lenses, presently marketed in Japan, are sold under the brand name of "CC Filter" lenses and include two types: CCP, and CCP-400, the latter allowing slightly more transmission of the visible spectrum. Both are manufactured from a CR-39 resin. Tokai medical lenses are available with six different transmission spectra and appear red, orange, yellow, light green, dark green, and brown in color. All are a fixed tint, and made of non photochromic material. This paper attempts to verify the claimed transmission characteristics of Tokai medical lenses through careful spectrophotometric analysis. Lenses with different transmission characteristics can be used to alleviate ocular symptoms. Research on the clinical application of such lenses is reviewed and discussed.

Procedure

A total of 12 different lenses were verified using a modified Varian DMS 200 UV/Visible/IR Spectrophotometer. The substrate carrier was modified to allow measurement through plastic lenses as the spectrophotometer's primary use is to measure transmission characteristics of liquids. Modification entailed the simple removal of the carrier such that lenses could be positioned centrally in the path of the analyzer. Using the transmission through air as a 100% transmittance base line, each lens was scanned from 280 nm to 800 nm and a printout of the transmission curves was obtained. As well, transmissions measured *at specific wavelengths*, were compared to values reported by Tokai Optical Company. These wavelengths included 280 nm (harmful UV-C radiation), 315 nm (harmful UV-A radiation), 400nm (end of the UV spectrum), 450 nm (scotopic sensitivity maximum), 550 nm (photopic sensitivity maximum) and 850 nm (infrared). These two measuring approaches allowed for direct comparisons between the present study's values and those reported by Tokai Optical Company.

Results

Spectrophotometric analysis of the study lenses revealed only minimal deviations from Tokai Optical Company's reported transmission characteristics. The lens that differed the greatest was the Amber CCP400. *At 450 nm*, this lens showed 11.4% *greater* absorption than was reported by Tokai Optical Company (Table 1). Spectrophotometer plots from Tokai Optical Company as well as those from the present study can be found in Appendix 1.

Overall, the average deviation for each CCP lens varied by no more than 1.29% between the present study and Tokai Optical Company's values. The present study's results revealed both over and under-estimation of transmittances reported by Tokai (Figure 1).

Table 1.

Percent light transmission of CCP lenses at specific wavelengths

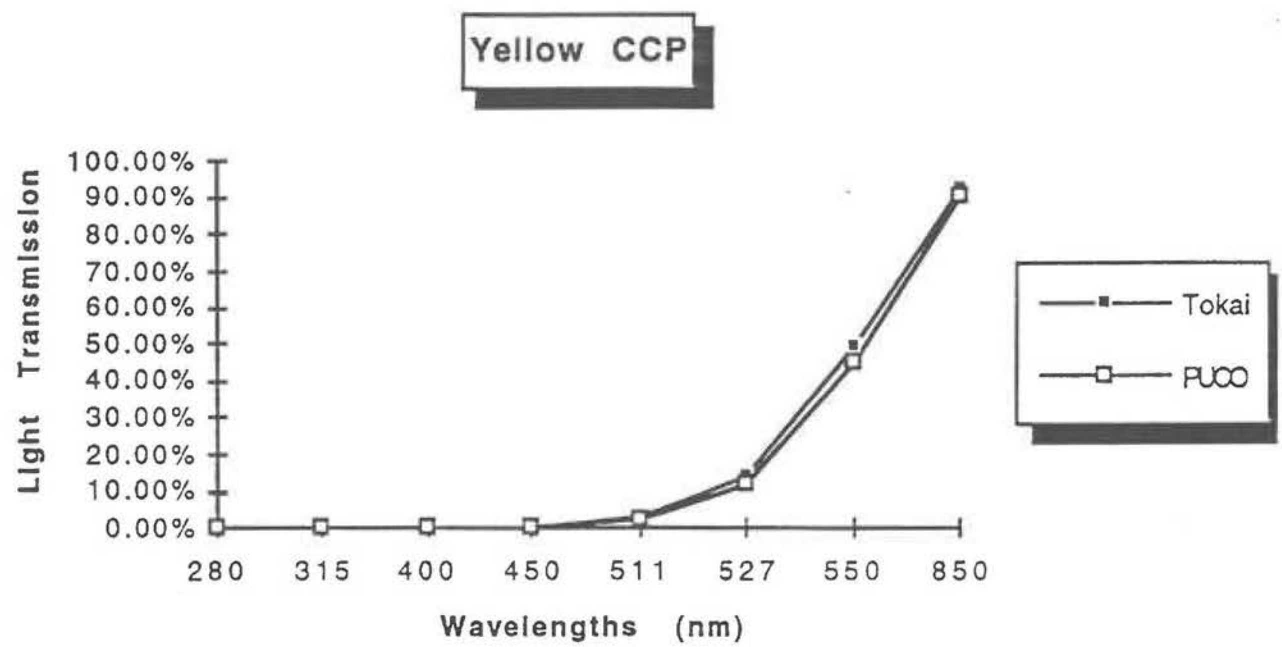
Colors:	Yellow			Orange			Red			Light Green			Dark Green			Brown		
	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference
280 nm	0.16%	0.00%	0.16%	0.18%	0.00%	0.18%	0.18%	0.00%	0.18%	0.24%	0.00%	0.24%	0.19%	0.00%	0.19%	0.15%	0.00%	0.15%
315 nm	0.14%	0.00%	0.14%	0.14%	0.00%	0.14%	0.13%	0.00%	0.13%	0.16%	0.00%	0.16%	0.16%	0.00%	0.16%	0.14%	0.00%	0.14%
400 nm	0.05%	0.00%	0.05%	0.06%	0.00%	0.06%	0.06%	0.00%	0.06%	0.06%	0.00%	0.06%	0.06%	0.00%	0.06%	0.06%	0.00%	0.06%
450 nm	0.05%	0.00%	0.05%	0.05%	0.00%	0.05%	0.06%	0.00%	0.06%	0.06%	0.00%	0.06%	0.06%	0.00%	0.06%	0.09%	0.00%	0.09%
511 nm	2.97%	2.30%	0.67%	1.07%	4.60%	-3.53%	0.45%	0.02%	0.43%	8.98%	9.50%	-0.52%	4.84%	6.30%	-1.46%	5.39%	5.30%	0.09%
527 nm	14.20%	12.10%	2.10%	5.81%	11.10%	-5.29%	1.23%	0.08%	1.15%	21.10%	22.10%	-1.00%	13.40%	15.80%	-2.40%	11.40%	11.10%	0.30%
550 nm	49.20%	45.10%	4.10%	27.50%	29.10%	-1.60%	6.44%	4.90%	1.54%	37.40%	39.70%	-2.30%	25.40%	29.10%	-3.70%	24.70%	25.60%	-0.90%
850 nm	92.50%	90.70%	1.80%	92.10%	92.40%	-0.30%	92.80%	91.10%	1.70%	92.40%	90.00%	2.40%	92.20%	91.70%	0.50%	92.60%	92.30%	0.30%
		Avg. %	1.13%		Avg. %	-1.29%		Avg. %	0.66%		Avg. %	-0.11%		Avg. %	-0.82%		Avg. %	0.03%

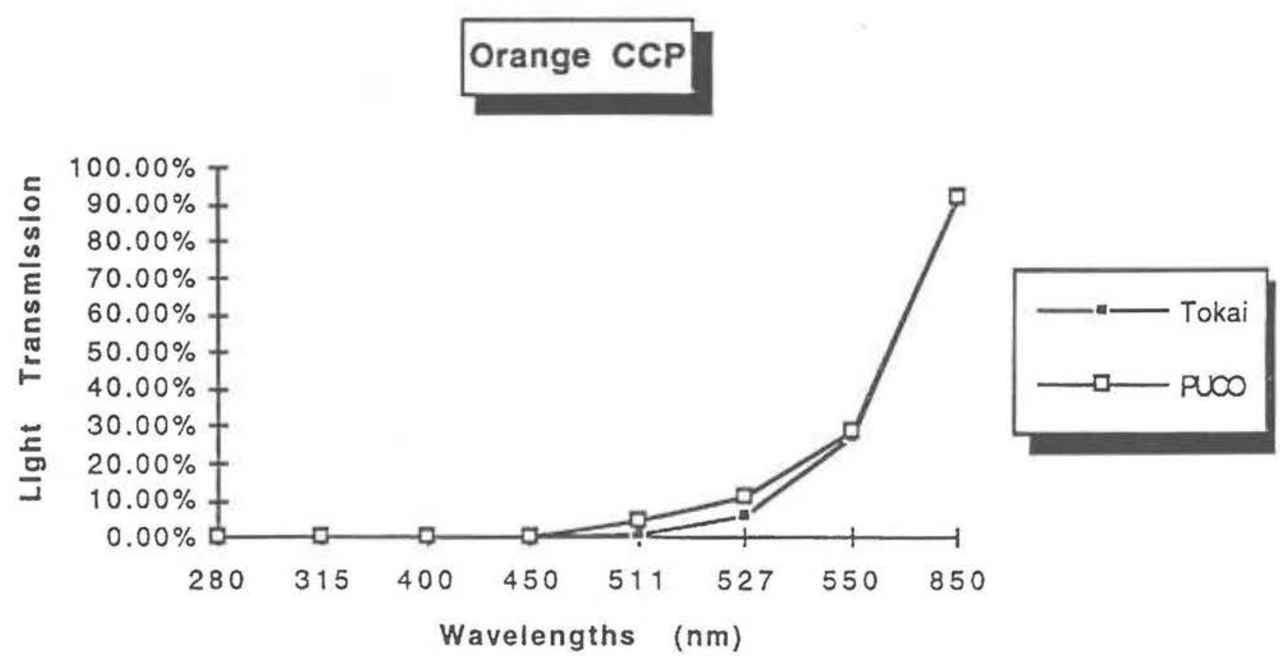
Percent light transmission of CCP400 lenses at specific wavelengths

Colors:	Amber			Light Green			Yellow			Green			Olive			Evergreen		
	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference	Tokai	PUCO	% Difference
280 nm	0.12%	0.00%	0.12%	0.35%	0.00%	0.35%	0.21%	0.00%	0.21%	0.11%	0.00%	0.11%	0.34%	0.00%	0.34%	0.15%	0.00%	0.15%
315 nm	0.07%	0.00%	0.07%	0.12%	0.00%	0.12%	0.14%	0.00%	0.14%	0.25%	0.00%	0.25%	0.21%	0.00%	0.21%	0.10%	0.00%	0.10%
400 nm	9.31%	6.80%	2.51%	13.40%	10.80%	2.60%	3.02%	1.20%	1.82%	7.31%	3.40%	3.91%	0.08%	0.00%	0.08%	0.73%	0.03%	0.70%
450 nm	53.60%	42.20%	11.40%	59.20%	58.10%	1.10%	26.40%	19.70%	6.70%	40.90%	35.10%	5.80%	2.43%	2.00%	0.43%	9.11%	7.50%	1.61%
511 nm	79.70%	75.10%	4.60%	79.50%	79.50%	0.00%	43.10%	38.10%	5.00%	55.60%	55.90%	-0.30%	10.40%	10.10%	0.30%	17.30%	15.70%	1.60%
527 nm	83.70%	80.04%	3.66%	80.30%	81.40%	-1.10%	47.70%	43.20%	4.50%	55.50%	56.60%	-1.10%	13.70%	13.40%	0.30%	17.90%	16.60%	1.30%
550 nm	88.40%	86.30%	2.10%	78.60%	81.10%	-2.50%	55.80%	51.40%	4.40%	53.60%	53.30%	0.30%	19.90%	19.60%	0.30%	18.00%	17.30%	0.70%
850 nm	92.70%	91.10%	1.60%	92.40%	91.40%	1.00%	92.50%	90.90%	1.60%	92.40%	90.30%	2.10%	92.00%	91.60%	0.40%	92.60%	90.80%	1.80%
		Avg. %	3.26%		Avg. %	0.20%		Avg. %	3.05%		Avg. %	1.38%		Avg. %	0.30%		Avg. %	1.00%

PUCO = Pacific University College of Optometry

Figure 1. Transmission spectra of Tokai Optical CCP lenses.





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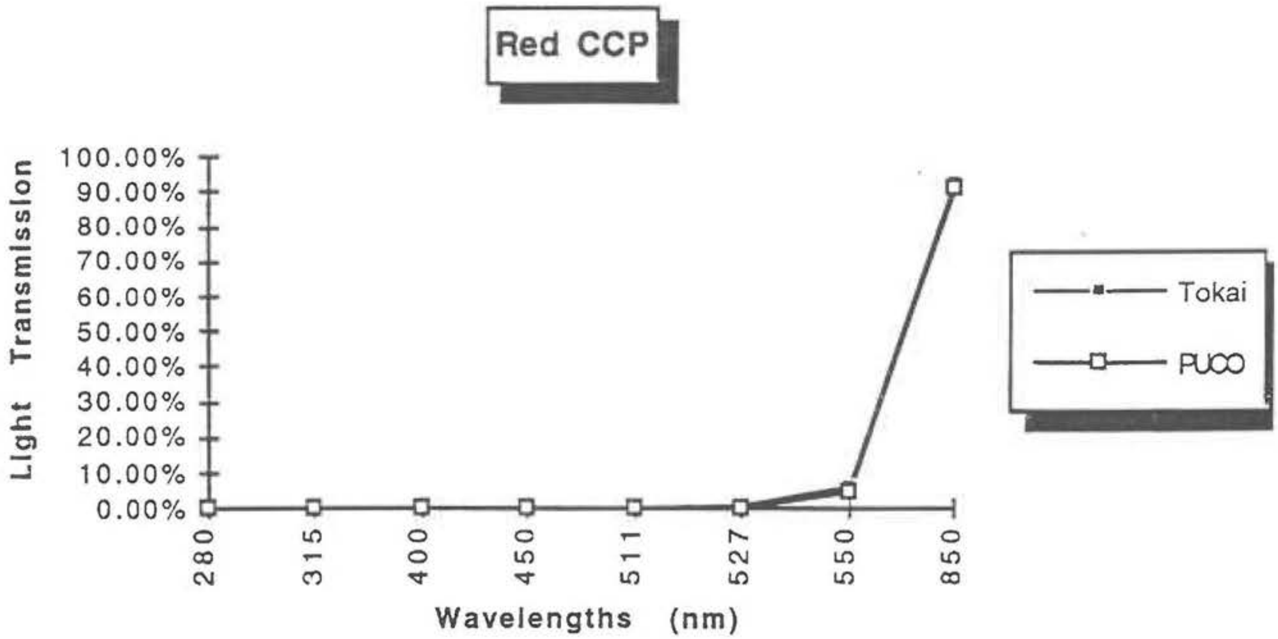

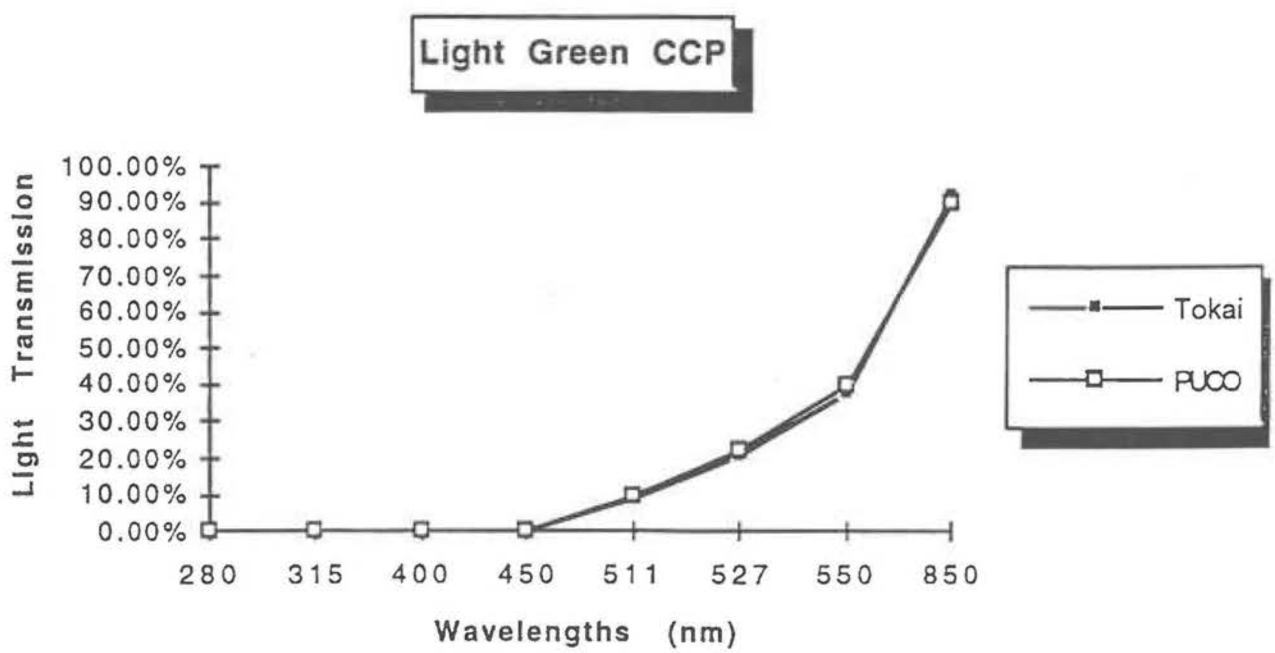

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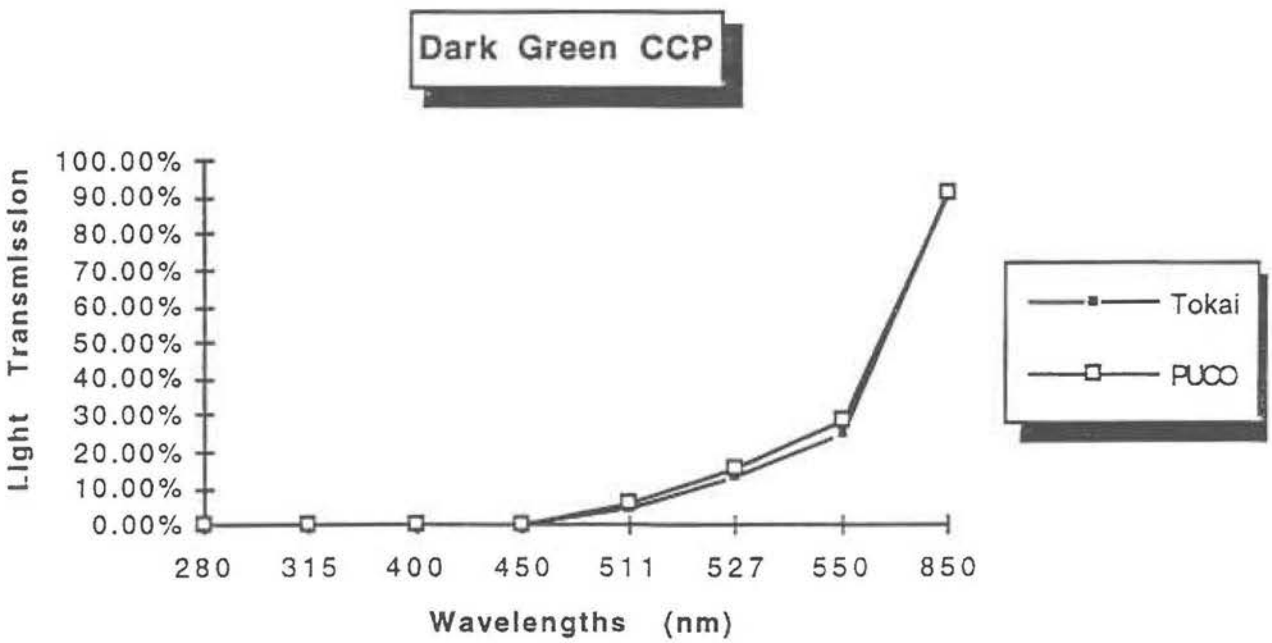

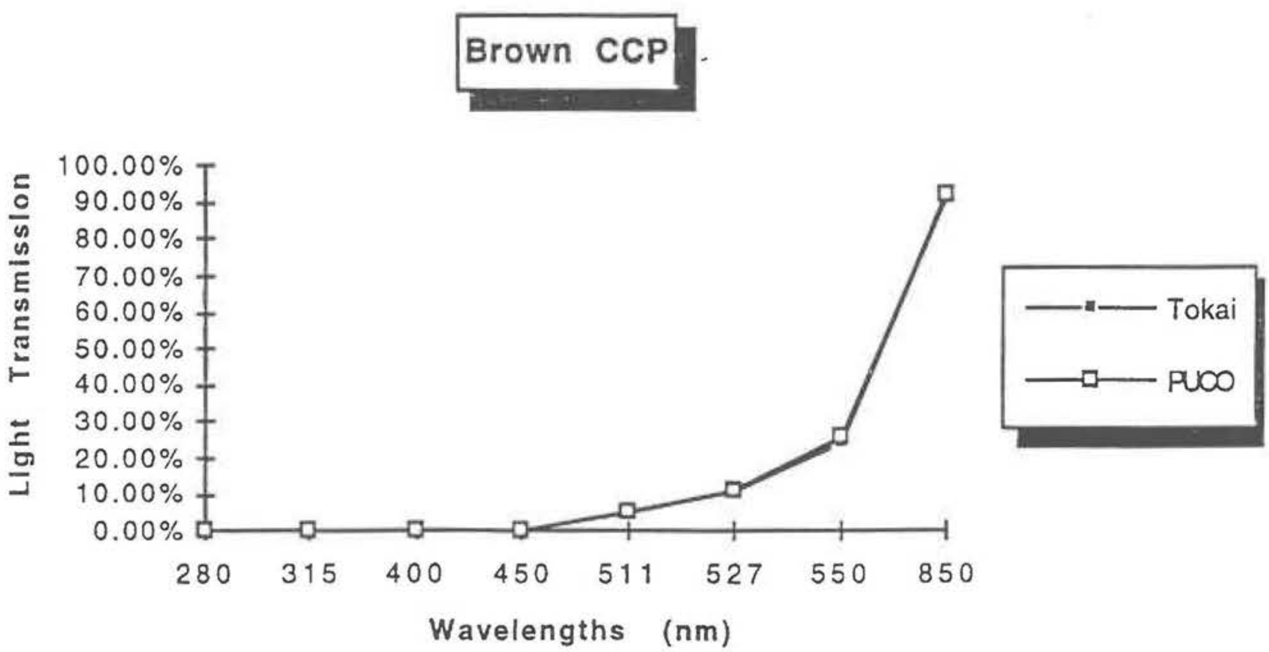

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The CCP400 lenses average-percent-difference in transmittance did not exceed 3.26% (Table 1). Curiously, Tokai Optical Company consistently *overestimated* transmittance relative to the values found in the present study. Therefore, Tokai Optical's CCP400 Lenses consistently absorbed *more* radiation than was claimed by the Company (Figure 2).

Discussion

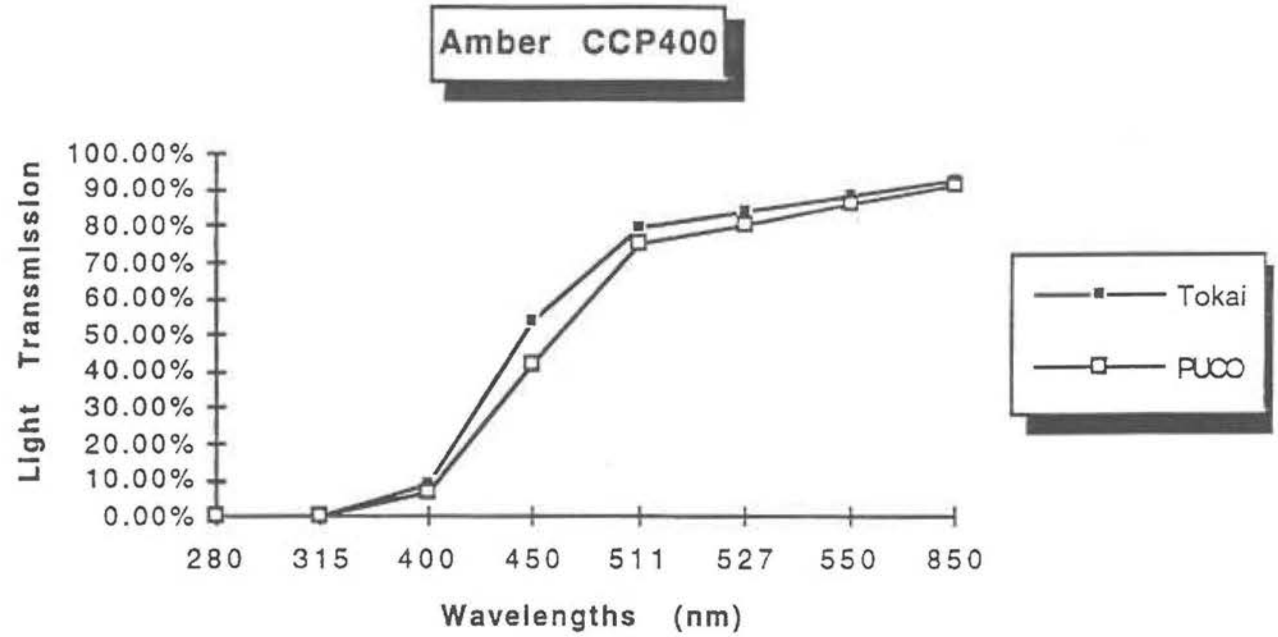
The present study supports Tokai Optical Companies claimed absorption characteristics of their medical lenses. Therefore, these lenses can be used for the purposes of their design, without hesitation, as they have been shown to perform to the levels claimed by the Company. The prescribing practitioner must, however, be aware of *how* patients will benefit from S.F. lenses as well as *who* will be best suited to them.

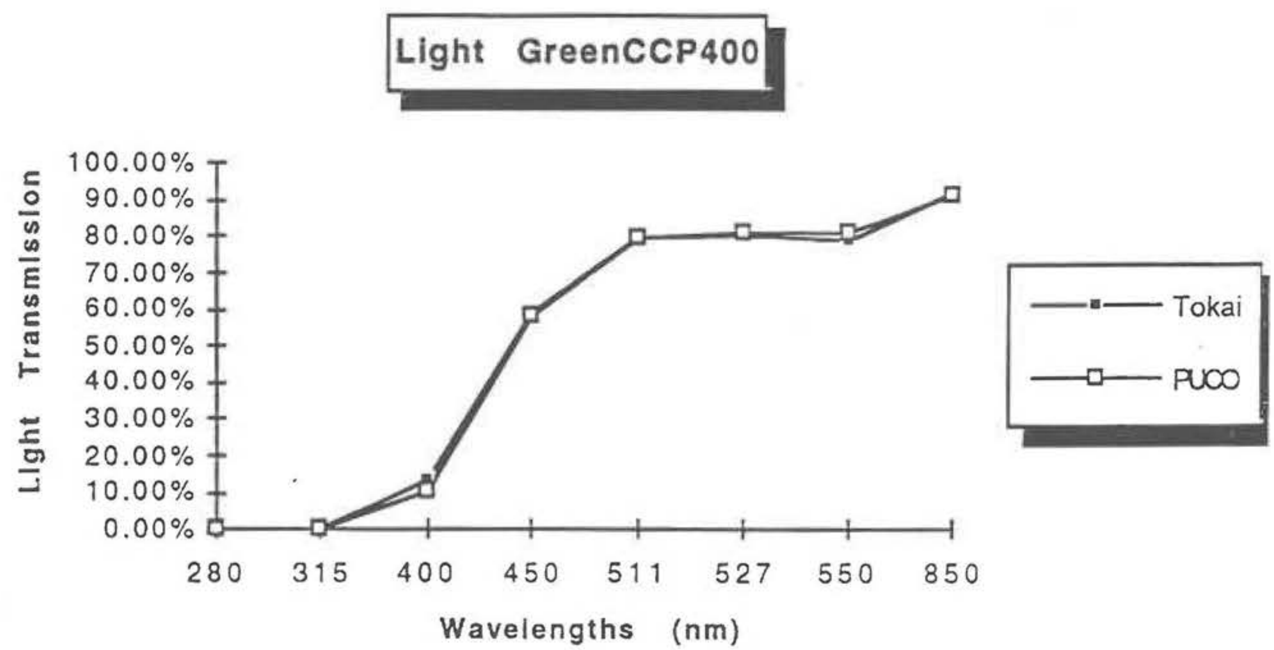
There are three proposed benefits from the use of tints and filters: (a) enhancement of visual performance in varying illuminations, (b) improved visual comfort; and (c) controlling the progression of ocular disease.[1] The latter is highly controversial and has proven difficult to assess. Patients with cataracts, retinitis pigmentosa, diabetic retinopathy, glaucoma, optic nerve atrophy, and maculopathies are among those who report improvements in visual functioning with S.F. lenes.[2]

Cataracts

Trokel[3], in his investigations into the physical basis for transparency of the crystalline lens, concluded that the primary basis for visual distortion produced by a cataract was an increase in light scattering. This finding is supported in the clinic by observing patients with early cataracts or corneal scars. These patients can usually read one or two more lines on the Snellen chart if the exam room lights are turned down.[4] This is because the room lights act as a source of glare thus decreasing the patients contrast sensitivity and therefore visual acuity. Neutral density filters will decrease the overall illumination entering the eye, reduce the scattering and hence increase contrast sensitivity and acuity; similar acuity

Figure 2. Transmission spectra of Tokai Optical CCP400 lenses.





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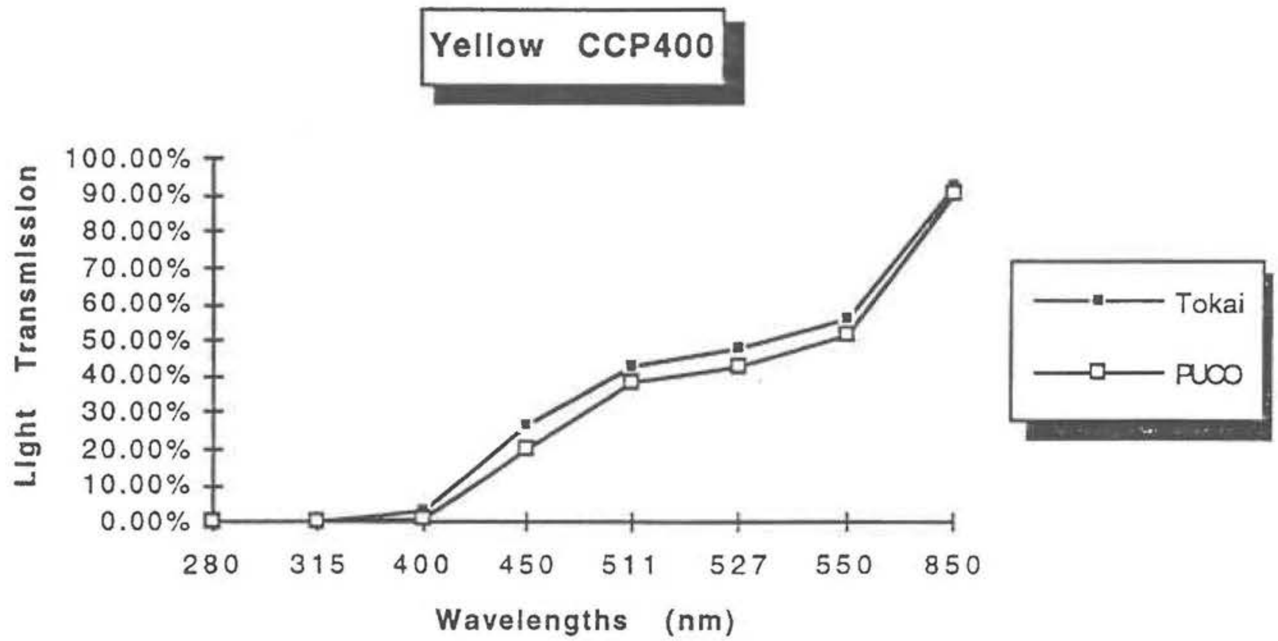

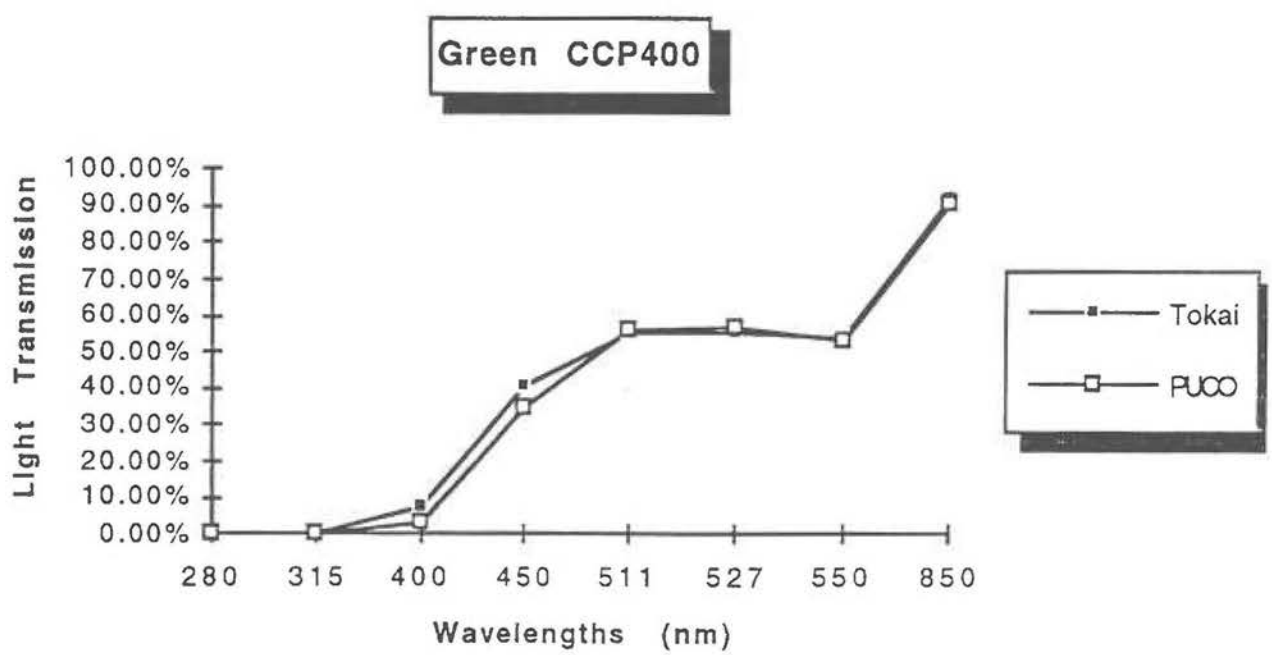

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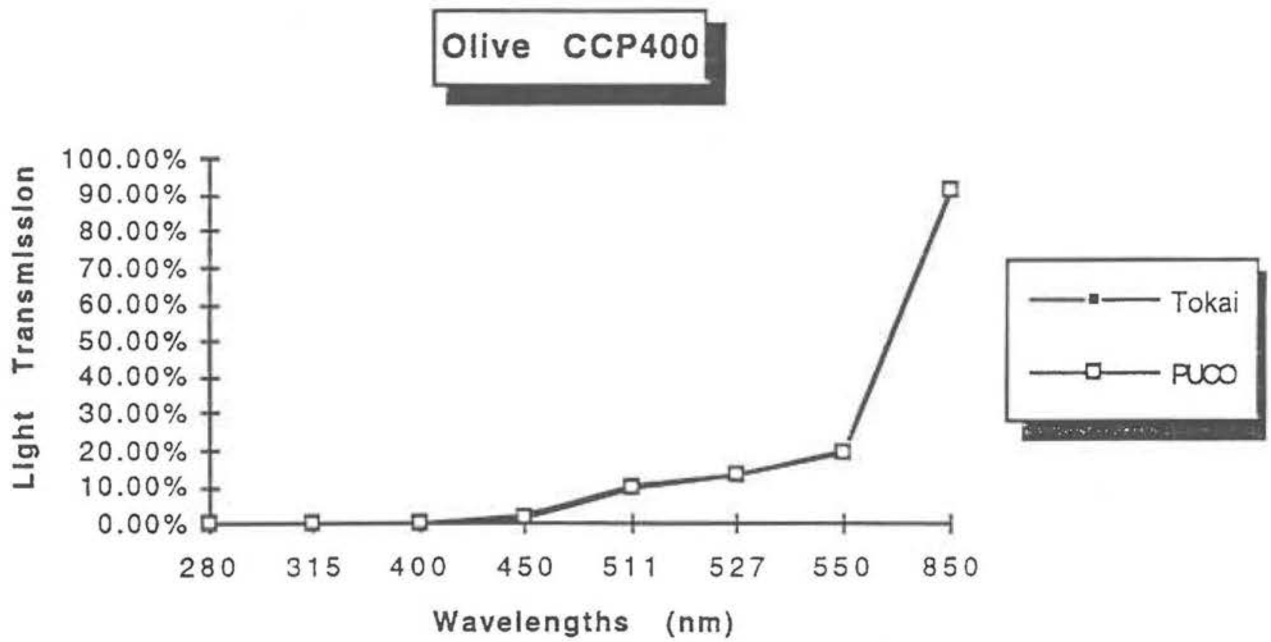

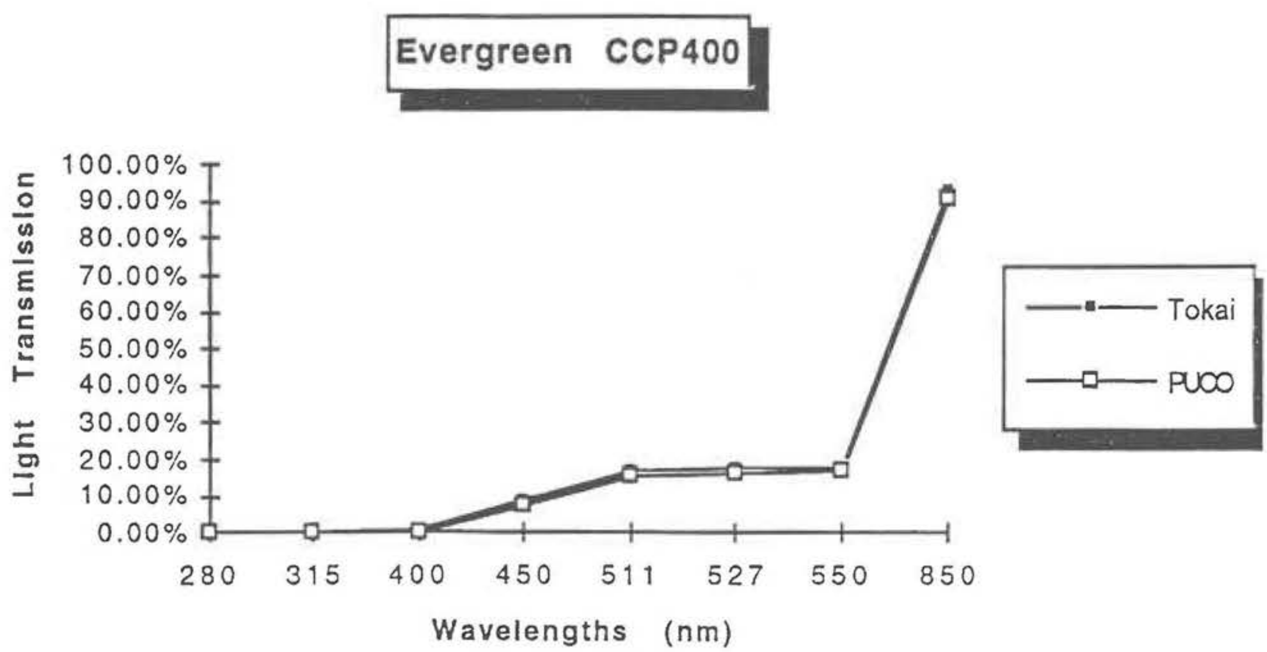

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increases can be seen by reducing levels of ambient light. Although most of the scattering produced by a cataract or scarred cornea is not wavelength dependent, some Raleigh scattering is present.[4] As shown in Figure 3., blue light Raleigh scatters approximately nine times more than the light we see at our maximum scotopic sensitivity level (555 nm, light green).

Figure 3. Raleigh scattering as a function of wavelength.

555nm, photopic sensitivity maximum	320 nm, blue light
$i=1/555^4$	$i=1/320^4$
$i=1.05 \times 10^{-11}$	$i=9.54 \times 10^{-11}$

Therefore, it would be logical that lenses which selectively absorb short wavelength light might further benefit the cataract patient. However, Bither[5] demonstrated that patients with media opacities preferred neutral density filters over such S.F. lenses. This finding is supported by Chou and Cullen[6] who suggested that shorter wavelengths only produce *slightly* more discomfort in situations of very intense illumination. Therefore, while Raleigh scattering does contribute to glare, more relief might result from reducing total illumination rather than selectively filtering high energy light.

Reducing scattered light, or overall illumination, is not the only means by which visual performance can be enhanced in patients with media opacities. Tupper[4] states that S.F. lenses blocking the blue end of the spectrum will sharpen most objects in the real world. He states, for example, that yellow-green leaves, red-yellow plants as well as the gray-brown branches stand out more vividly against the blue sky. Therefore, regardless of light scattering, by using an optical filter that absorbs short light wavelengths, the world of colored objects is slightly distorted but its contrast can be much enhanced. Practitioners must also keep in mind the beneficial effects of reducing incident blue light to help slow the progression of cataracts.

Retinitis Pigmentosa

Retinitis Pigmentosa (R.P.) is a degenerative genetic condition resulting in debilitating vision loss. Initially, the R.P. patient loses night vision as a result of the initial loss of rod vision, also causing the patient to experience tunnel vision.[7] This is followed eventually by the loss of cone vision. Patients with R.P. very often experience difficulties in bright conditions thought to be due to an abnormal recovery time after bleaching.[2] It has been proposed that extended exposure to light, especially high energy short wavelength light, might exacerbate pigmentary retinal degeneration's such as R.P. This phenomenon was demonstrated by Dowling and Sidman in 1962[5], in certain pink eyed rats with inherited retinal dystrophy's. Berson[8], however, showed through his conclusive studies in long term monocular occlusion, that the progression of R.P. *did not* slow in the absence of light. However, because of the known benefits to ocular tissue and the many subjective reports of increased comfort, practitioners should not hesitate to prescribe S.F. lenses to R.P. patients.[9,7] When introduced in 1981, the Corning CPF 550 lens was touted as the first filter designed specifically for the R.P. patient.[10] The CPF lens is photochromic, and appears red as it absorbs light in the blue end of the spectrum. Morrisette et al.[11] found that 26 out of 36 R.P. patients who tried this lens accepted it and reported such improvements as decreased dark adaptation time, fewer headaches and improved visual functioning and comfort when compared to a non tinted lens. Lynch and Brilliant.[12], comparing the Corning CPF lens (S.F. lens) with Noir neutral density filters, found slight acuity increases in 23 out of 30 eyes tested, while no differences in contrast sensitivity or adaptation times could be elicited. Silver and Lyness[13], in their study titled "Do retinitis pigmentosa patients prefer red *photochromic* lenses" concluded that most all R.P. patients subjectively prefer the use of a filtering lens, however there was no evidence that patients preferred a *photochromic* red lens over a fixed red tint. He continued that a significant number of patients *did* prefer the photochromic lenses but just as many subjects disliked them and therefore the consciences prescriber must have reservations about prescribing any tint without a trial.

Interestingly, it has been shown that neutral density filters actually result in a considerable *reduction* in visual performance (acuity measured under different conditions); no reduction in performance was demonstrated with S.F. lenses.[1]

Macular degeneration

Age related macular degeneration (A.R.M.D.) accounts for 9500 new cases of legal blindness each year in the United States[2] and is the leading cause of blindness in the Western World.[14] There are many reported functional changes associated with A.R.M.D. including: glare, reduced contrast sensitivity, reduced acuity and impaired color discrimination[2]. It is well established that filters will decrease incident light thus decreasing amount of scatter and associated discomfort. Similarly, it is well established that in many conditions, S.F. lenses lead to a *subjective* increase in comfort and performance. Leat et al[1]. studied low vision patients with 17 presenting conditions and objectively compared differences in performance through neutral density filters and S.F. lenses. Leat states that while subjective improvements were noted, patients suffering from macular or retinal degeneration's tend to benefit the least by using filters of any kind. Corning Optical[15] however, states that A.R.M.D. patients are the primary users of their S.F. lenses, thus suggesting that visual performance or comfort, whether subjective or objective, is significantly enhanced through their use.

Leat[1] studied objective contrast sensitivities of patients with a wide variety of ocular conditions. Performance was evaluated under conditions of glare and under normal illumination with neutral density filters and a variety of S.F. lenses. Of the 44 subjects taking part, less than one-half showed improvement with any filter. She concluded that in the glare free conditions, people with posterior pole disease, such as maculopathies, retinopathies (diabetic, hypertensive) are more representative of the group gaining no improvement. Alternatively, anterior eye conditions (albinism, coloboma, aniridia, media opacities) are more numerous amongst the group gaining improvement with S.F. lenses. Similarly under glare conditions she reports more improvement was noted with those with anterior eye conditions and more improvement was noted with S.F. lenses than with neutral density. While there may be a relationship between pathological etiology and the preference of a neutral density or a S.F. lens, there does not appear to be a correlation between etiology and the *absorptive properties* of the S.F. chosen. This was demonstrated in Nguyen and Hoeft's 1994 study on Corning blue blocker filters and related pathologies. Their investigation demonstrated that there was no correlation between location of the ocular pathology and the transmission cutoff point of the S.F. lens chosen.[16]

Conclusion:

Although the potential benefits of S.F. lenses, on comfort and visual performance, have long been realized, relatively few companies have invested in their production. The present paper supports Tokai Optical Companies reported transmittance curves of their medical lenses. Results show reported transmissions differed from the present study's, by no more than 3.5 percent transmittance with the majority differing by less than 1 percent. While some trends are evident, in general, research on the benefits derived from using such lenses remains uncertain. The reviewed literature suggests cataract patients prefer a more neutral density filter under normal conditions while in conditions of high glare, some selective filtering characteristics proved beneficial. Evidence suggests, to increase patient comfort, more emphasis should be placed on reducing the *total* amount of incident light. However, because blue light is thought to exacerbate cataract development, S.F. lenses would likely be of benefit.

Patients with retinitis pigmentosa experienced subjective improvements in visual comfort and performance with S.F. lenses relative to neutral density filters. An objective increase in acuity was demonstrated with a significant number of patients with S.F. lenses. Literature suggests there is no strong preference for *photochromic* lenses over a fixed tint. Visual performance may

actually be compromised with the use of a neutral density filter. Considering the literature reviewed, R.P. patients may greatly benefit from S.F. lenses, both in comfort and acuity.
Patients suffering from macular degenerative conditions were shown to be among the group benefiting the least from *any* filter in normal lighting conditions however, under glare situations, S.F. lenses tended to be more beneficial than neutral density lenses. In general, people with age related macular degeneration see improvement in acuity and contrast sensitivity with increased illumination and thus a neutral density filter may be contraindicated.

It must be stressed that the literature reviewed reports *trends* , and in a clinical situation, individuals are likely to vary in their preferences when attempting to chose a medical lens. Unless patients are having difficulty meeting a desired acuity demand, the practitioner should rely more on the patients *subjective* responses rather than objective findings when choosing a medical lens. With new lenses entering the market this task may be made more difficult but the potential rewards to patients may be tremendous.

References:

1. Leat SJ, North RV, and Bryson H. Do long wavelength pass filters improve low vision performances? Ophthal Physiol Optics 1990; 10:219-224.

2. DeSylvia D. Low vision and aging. Optom and Vision Sci 1990; 67:(5) 319-322.

3. Trokel S. The physical basis for transparency of the crystalline lens. Invest Ophthal 1962; 1:493-500.

4. Tupper B, Miller D, and Miller R. The effect of a 550 nm cutoff filter on the vision of cataract patients. Annals of Ophthal 1985; 17(1): 67-72.

5. Bither PP, Hurt JD. CPF-550 vs. C-Lite: a comparison study. Journal of the Amer Optom Assn 1988; 59:(8) 623-628.

6. Chou BR, Cullen AP. Spectral characteristics of sports and occupational tinted lenses. Canadian J of Optom 1985; 47:77-88.

7. Yolton RL. Student's guide to visual information processing and perception. Pacific University College of Optometry. 14,168.

8. Berson EL. Light deprivation in retinitis pigmentosa. Vis Res 1980; 20:1179-84.

9. Woo GC, and Hackner AJ. An update on therapies for retinitis pigmentosa. Canadian J of Optom 1981; 43(1): 46-48.

10. Pensyl CD. Matching patient needs with the features of photochromic filters. J of Vision Rehab 1993; 7:(1) 10-12.

11. Morrissette DL, Mehr EB, Keswick CW and Lee PN. Users' and nonusers' evaluations of the CPF 550 lenses. Am J of Optom and Phsiol Optics 1984; 61:(11) 704-710.

12. Lynch DM, Brilliant R. An evaluation of the Corning CPF550 Lens. Optom Monthly 1984; 75:36-42.

13. Silver JH and Lyness AL. Do retinitis pigmentosa pateients prefer red photochromic lenses? Ophthalmological Physiol Optics 1985; 5(1): 87-88.

14. Kanski JJ. Clinical ophthamology. London: Butterworth-Heinemann, 1990. 349-355.

15. Corning Medical Optics. Corning glare control lens manual 1991. Corning NY.

16. Nguyen TV and Hoeft WW. A study of Corning blue blocker filters and related pathologies. J of Vision Rehab 1994; (8):3 15-21.

Appendix 1. Spectrophotometer plots of percent transmission versus wavelength of Tokai Medical Lenses.

Pacific: Yellow CCP

```
Trace    A                        Operator              Sample
Mode     %T                       SBW (nm)    2.0       Smoothing (sec) 0.2
Ord Max/Min    100.0    0.0       WL Max/Min (nm)  800.0   280.0
Speed (nm/min)   200
     5 Peaks, threshold    1.0
Max  771.6 nm,   90.9   Max  706.9 nm,   90.0
Max  571.3 nm,   89.5   Max  558.1 nm,   88.5
Max  539.3 nm,   87.0
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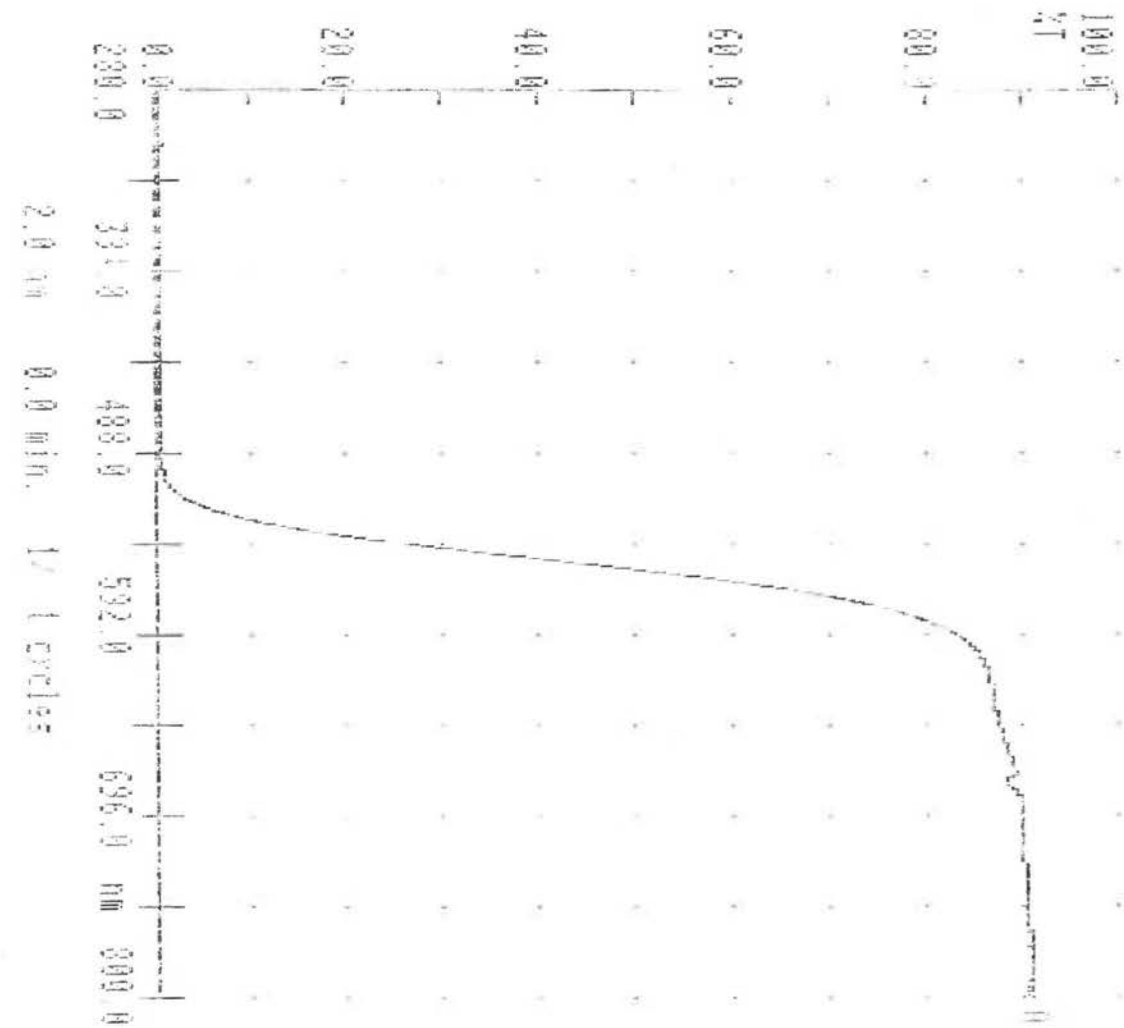
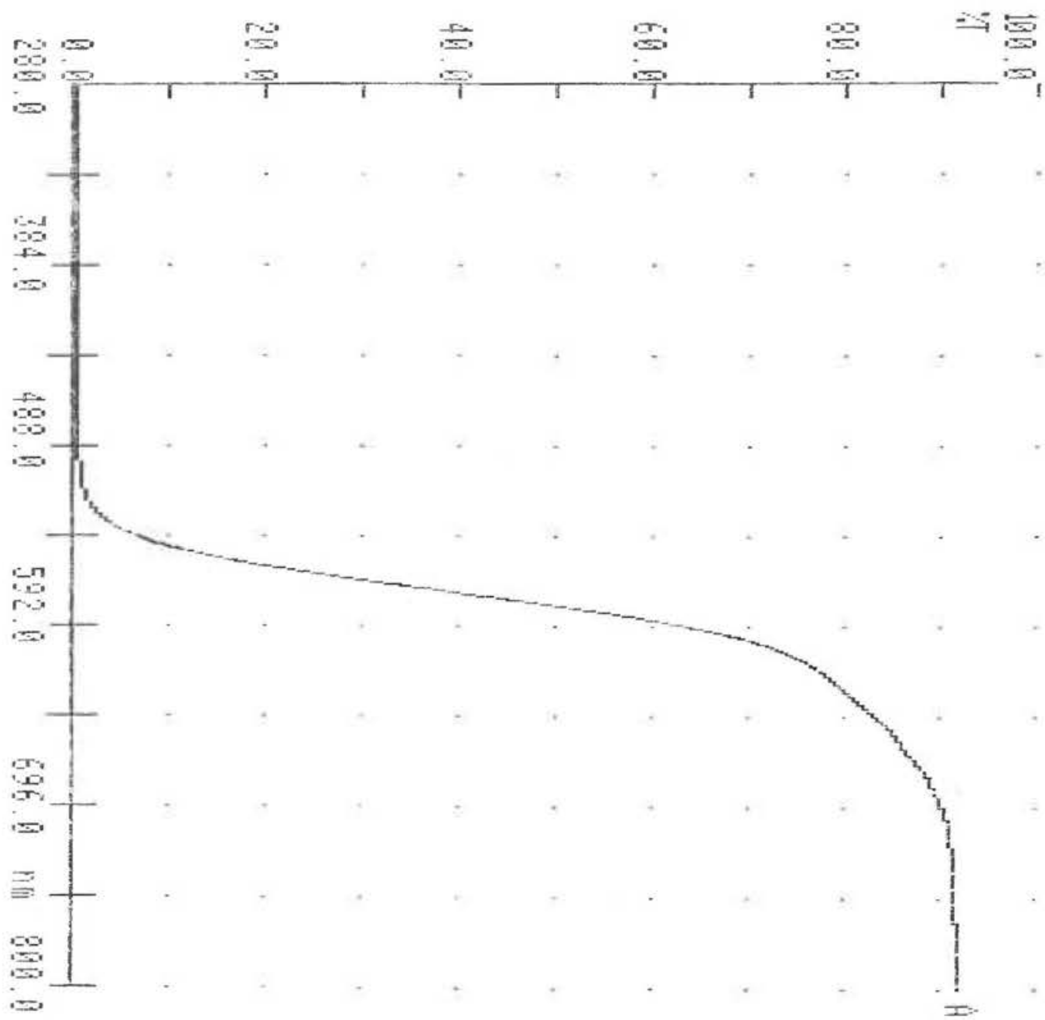


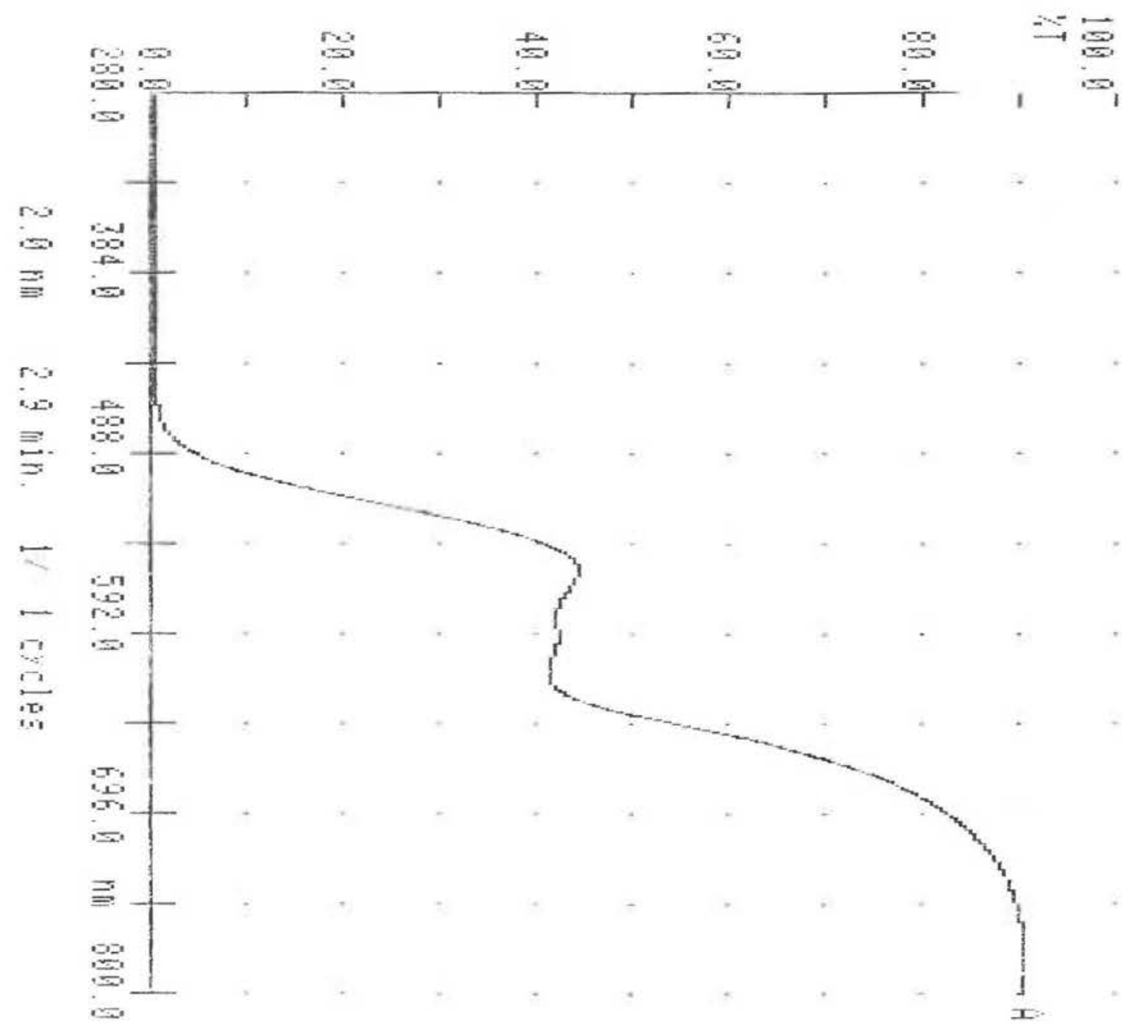
Pacific: Orange CCP

Trace			Operator		Sample	
Mode	%T		SBW (nm)	2.0	Smoothing (sec)	1
Ord Max/Min	100.0	0.0	WL Max/Min (nm)	800.0 280.0		
Speed (nm/min)	200					
Cycles	1		Time (min/cyc)	2.9		



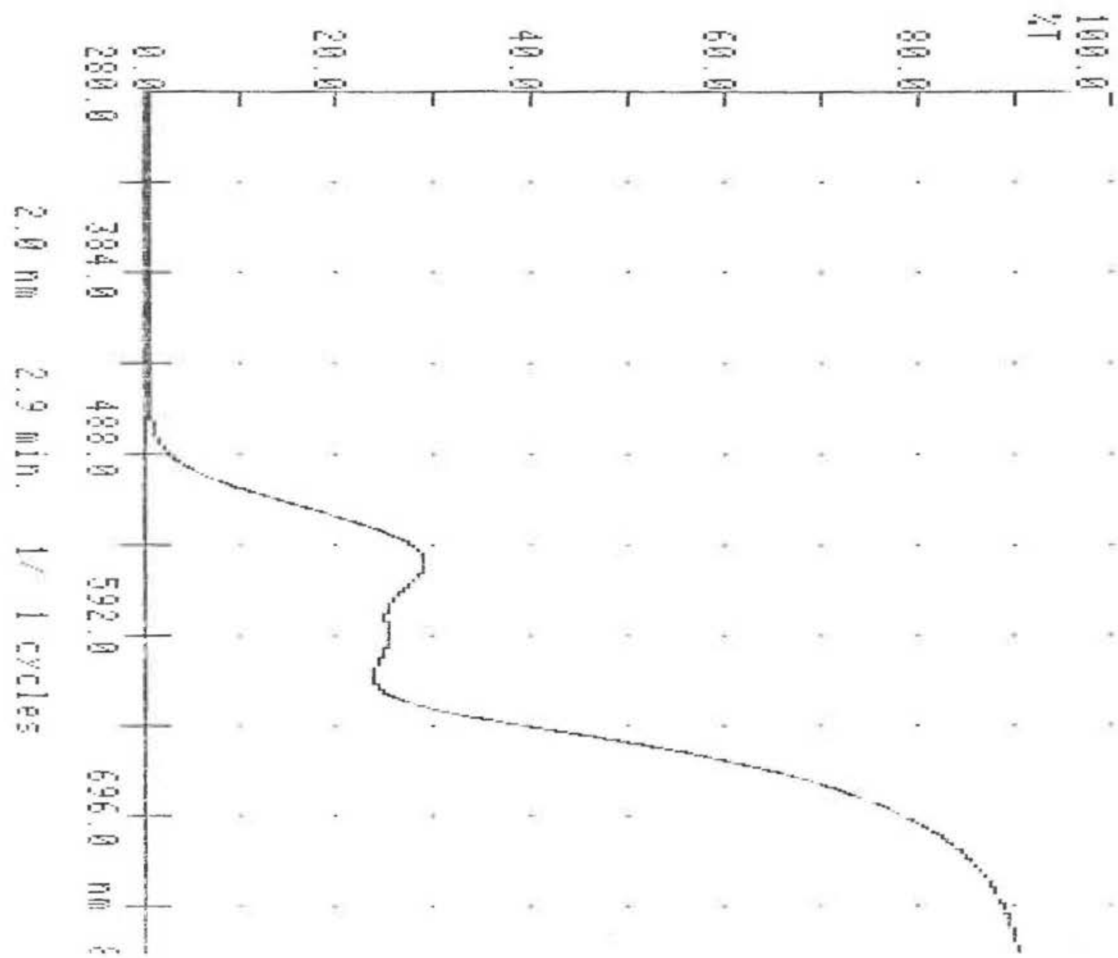
Pacific: Light Green CCP

Trace			Operator			Sample	
Mode	%T		SBW (nm)	2.0		Smoothing (sec)	1
Ord Max/Min	100.0	0.0	WL Max/Min (nm)	800.0	280.0		
Speed (nm/min)	200						
Cycles	1		Time (min/cyc)	2.9			



Pacific: Dark Green CCP

Trace			Operator		Sample	
Mode	%T		SBW (nm)	2.0	Smoothing (sec)	1
Ord Max/Min	100.0	0.0	WL Max/Min (nm)	800.0 280.0		
Speed (nm/min)	200					
Cycles	1		Time (min/cyc)	2.9		



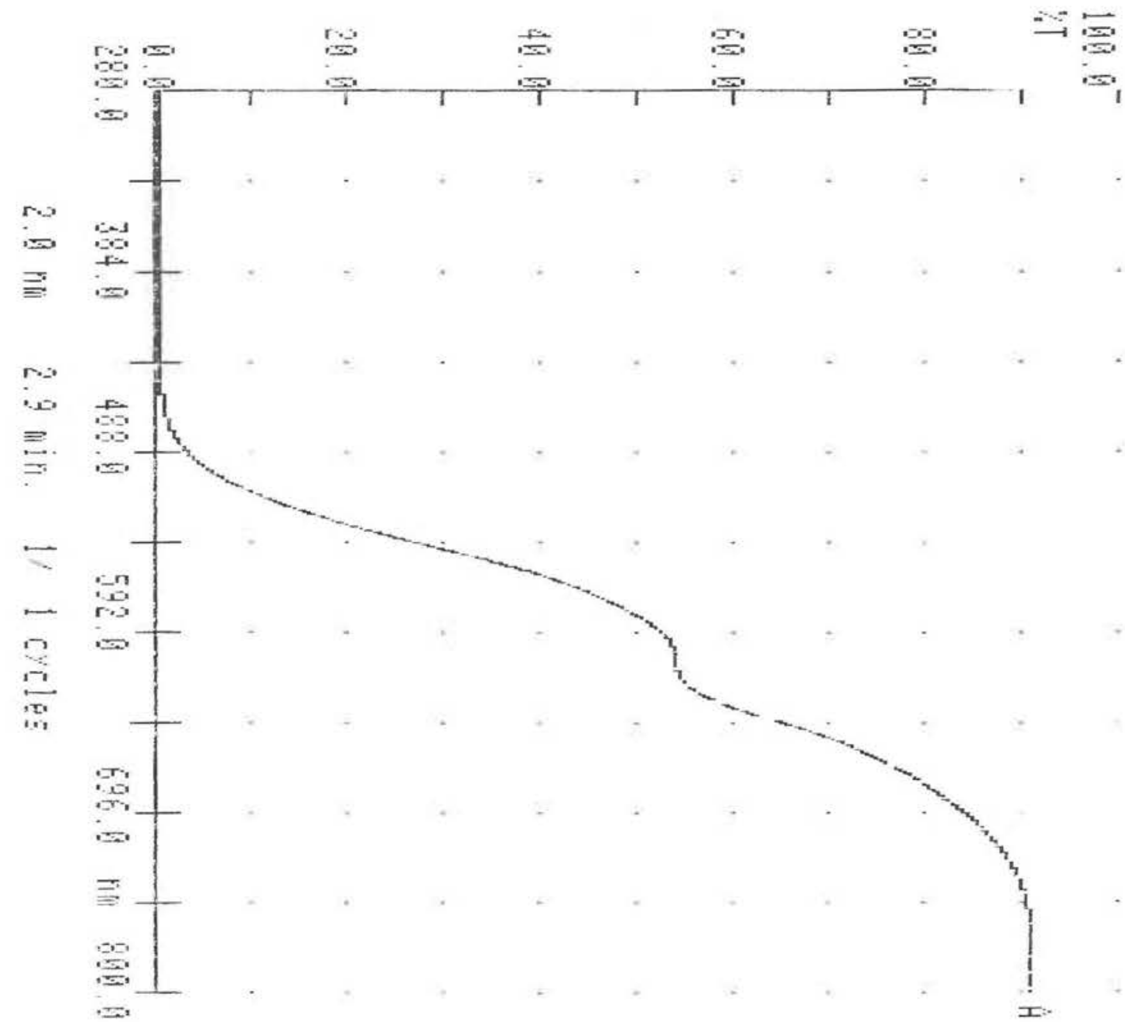
Pacific: Brown CCP

Trace
Mode %T
Ord Max/Min 100.0 0.0
Speed (nm/min) 200
Cycles 1

Operator
SBW (nm) 2.0
WL Max/Min (nm) 800.0 280.0

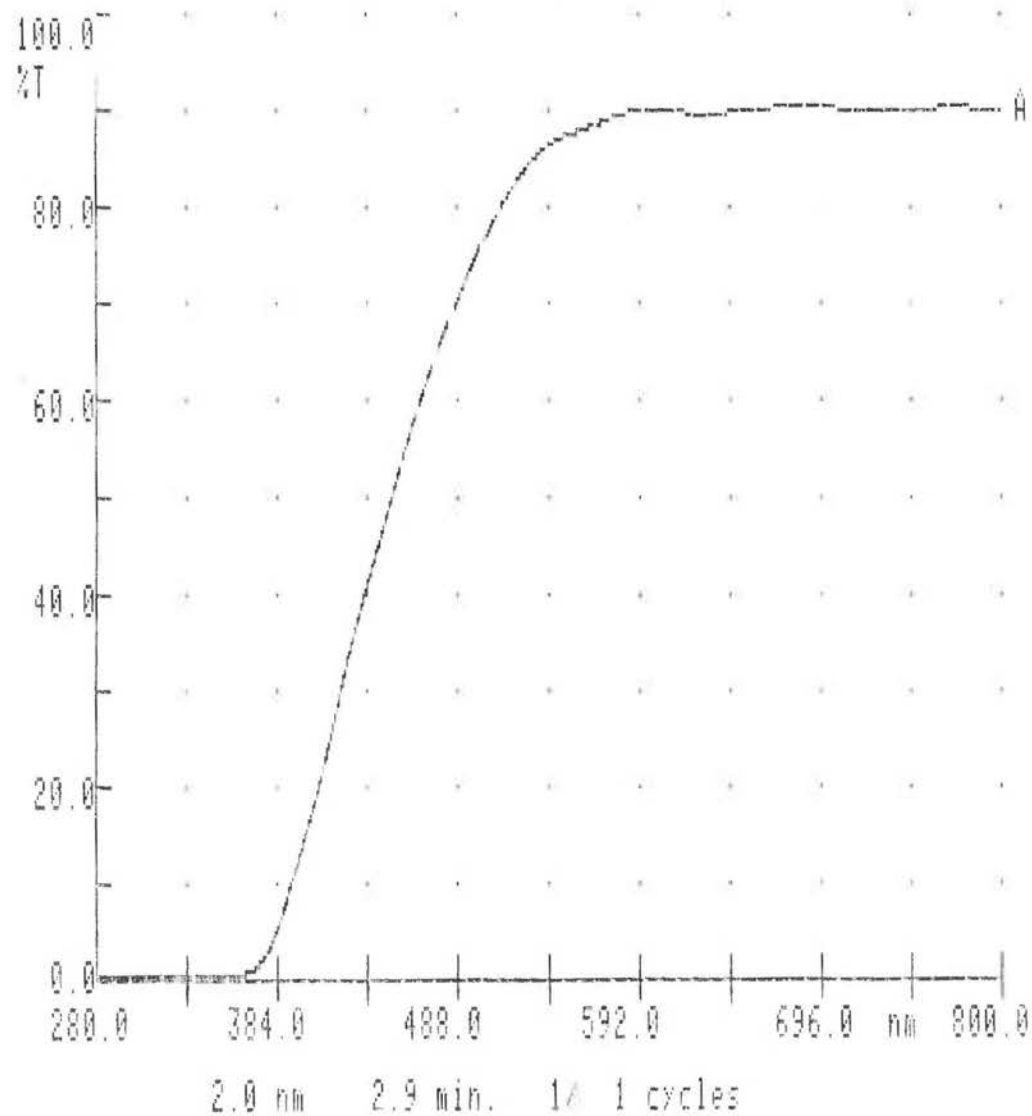
Time (min/cyc) 2.9

Sample
Smoothing (sec) 1



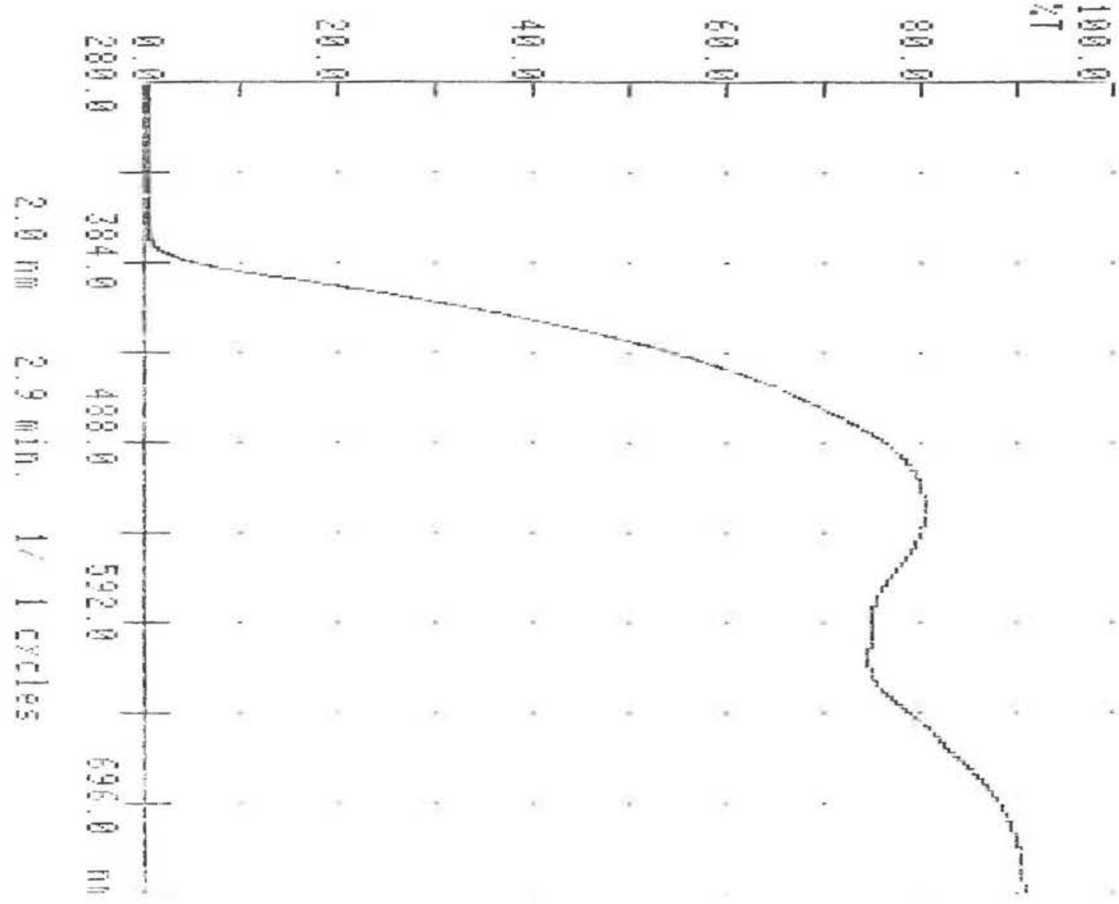
Pacific: Amber CCP400

Trace		Operator		Sample	
Mode	%T	SBW (nm)	2.0	Smoothing (sec)	
Ord Max/Min	100.0 0.0	WL Max/Min (nm)	800.0	280.0	
Speed (nm/min)	200				
Cycles	1	Time (min/cyc)	2.9		



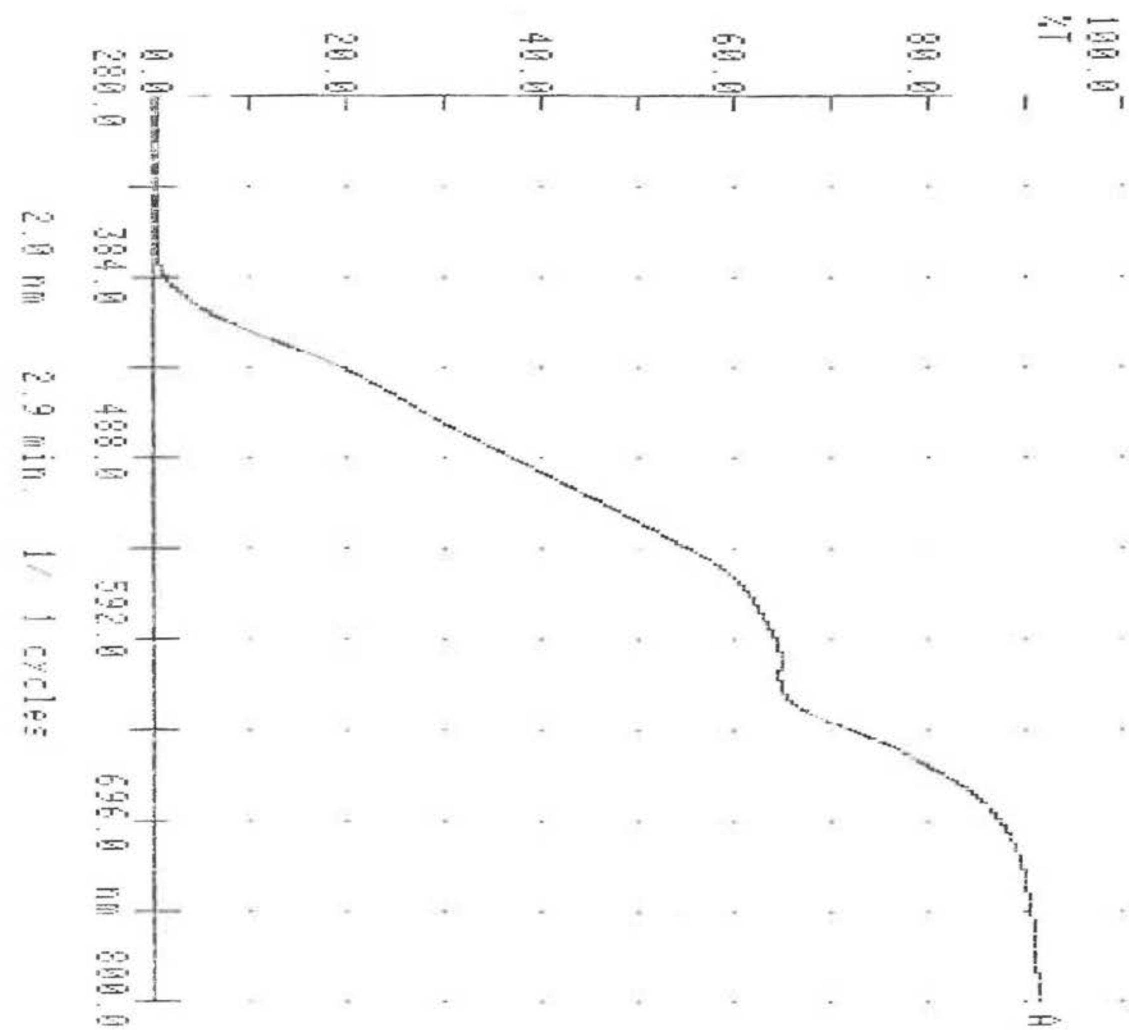
Pacific: Light Green CCP400

Trace			Operator		Sample	
Mode	%T		SBW (nm)	2.0	Smoothing (sec)	1
Ord Max/Min	100.0	0.0	WL Max/Min (nm)	800.0	280.0	
Speed (nm/min)	200					
Cycles	1		Time (min/cyc)	2.9		



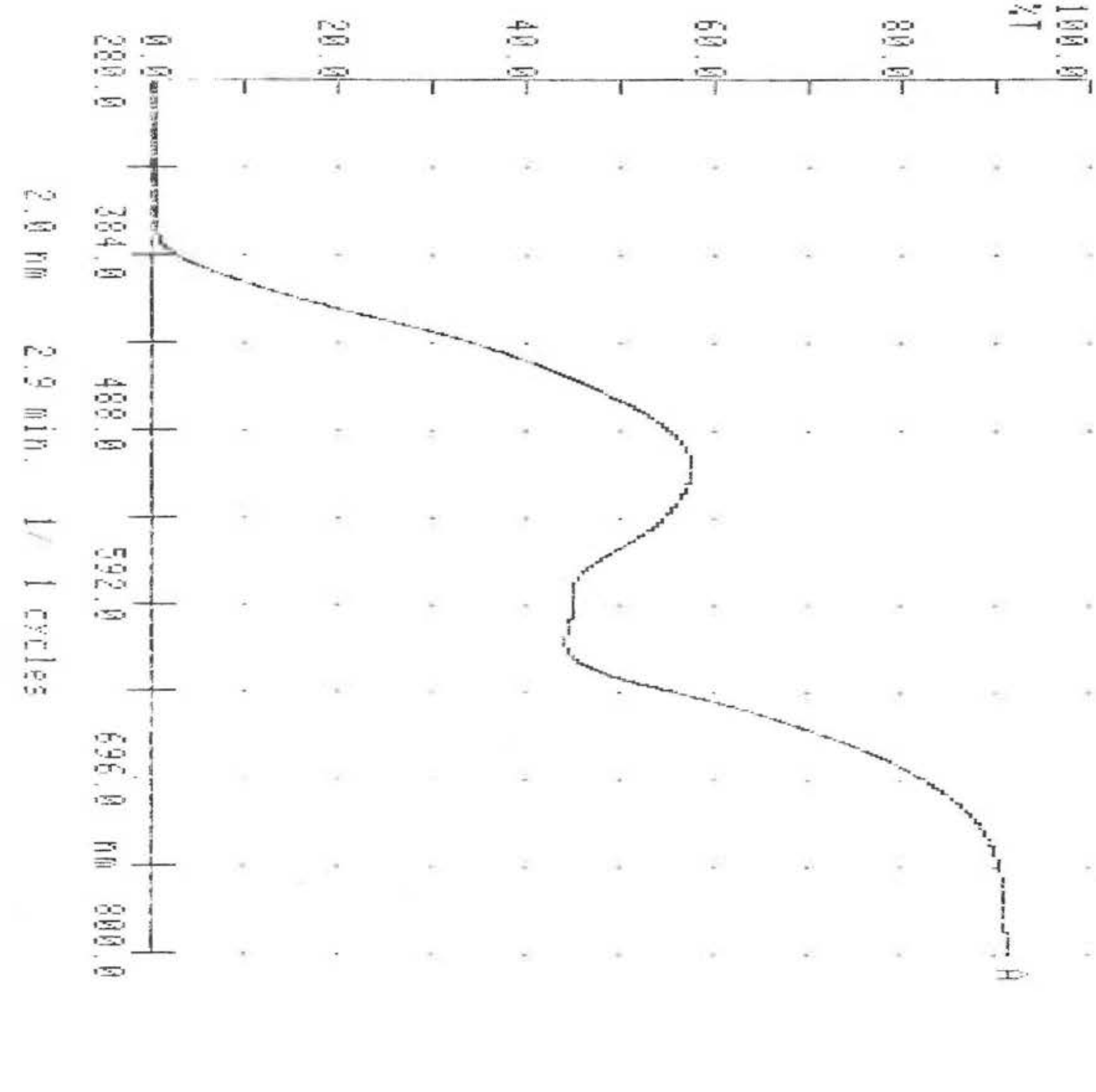
Pacific: Yellow CCP400

Trace			Operator		Sample	
Mode	%T		SBW (nm)	2.0	Smoothing (sec)	1
Ord Max/Min	100.0	0.0	WL Max/Min (nm)	800.0	280.0	
Speed (nm/min)	200					
Cycles	1		Time (min/cyc)	2.9		



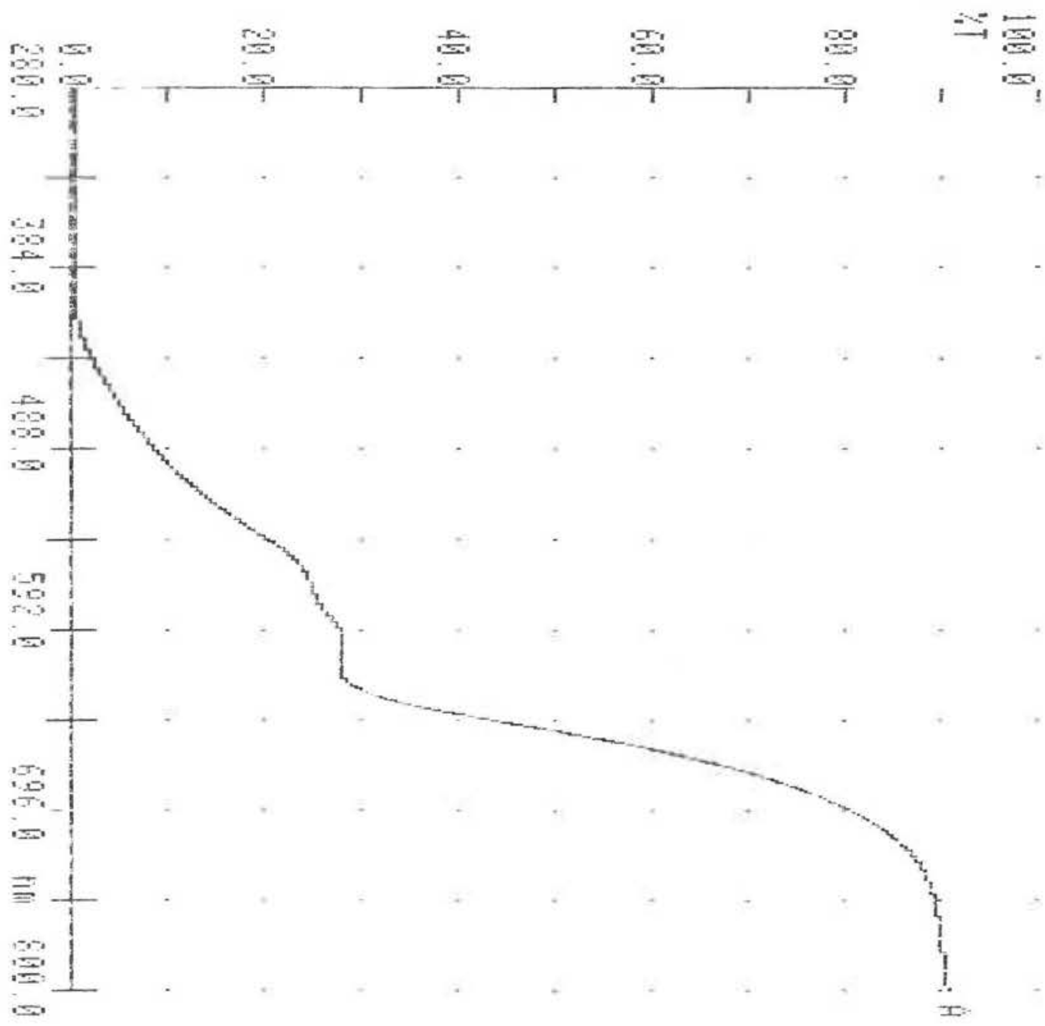
Pacific: Green CCP400

Trace			Operator		Sample		
Mode	%T		SBW (nm)	2.0	Smoothing (sec)		1
Ord Max/Min	100.0	0.0	WL Max/Min (nm)	800.0	280.0		
Speed (nm/min)	200						
Cycles	1		Time (min/cyc)	2.9			



Pacific: Olive CCP400

Trace			Operator		Sample	
Mode	%T		SBW (nm)	2.0	Smoothing (sec)	1
Ord Max/Min	100.0	0.0	WL Max/Min (nm)	800.0	280.0	
Speed (nm/min)	200					
Cycles	1		Time (min/cyc)	2.9		

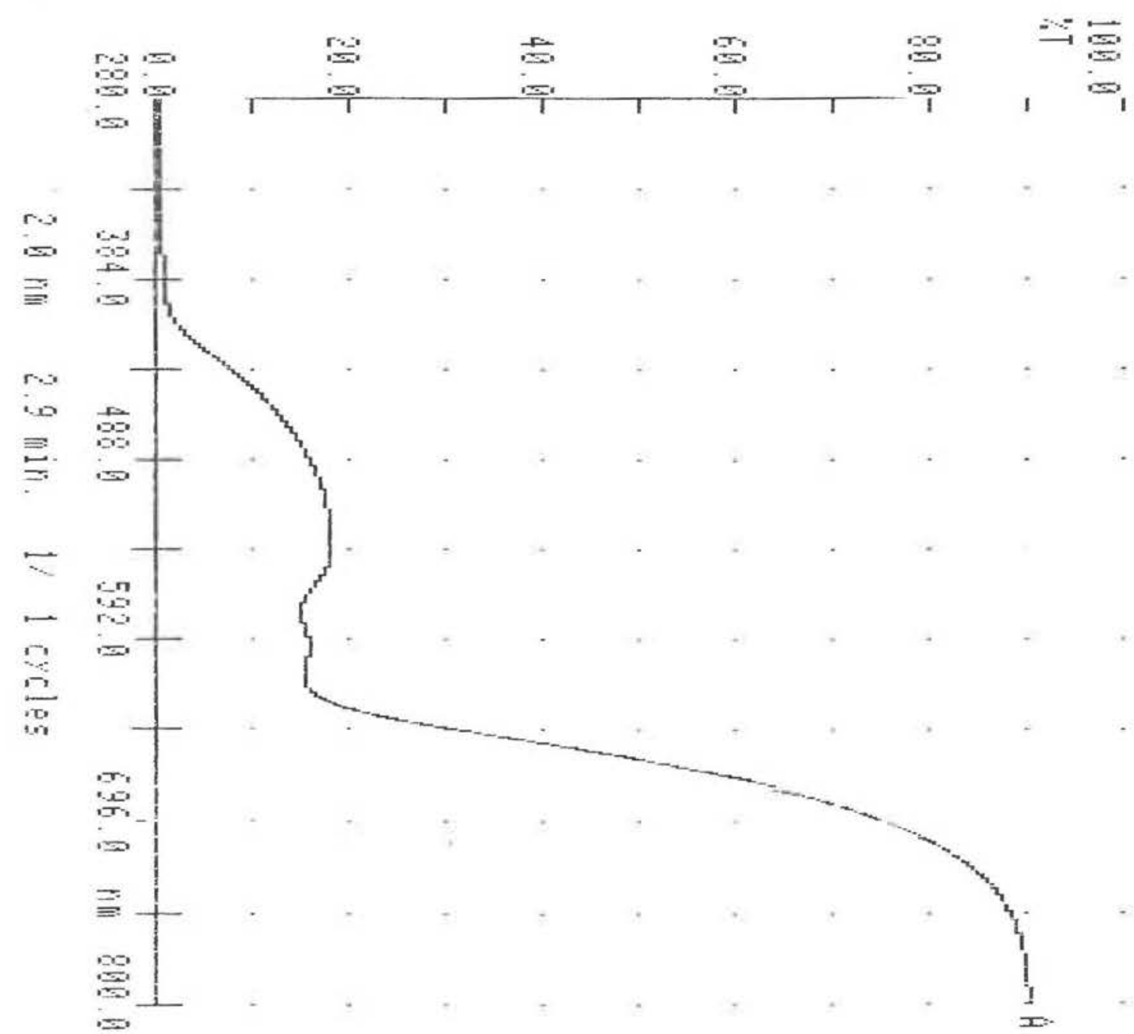


Pacific: Evergreen CCP400

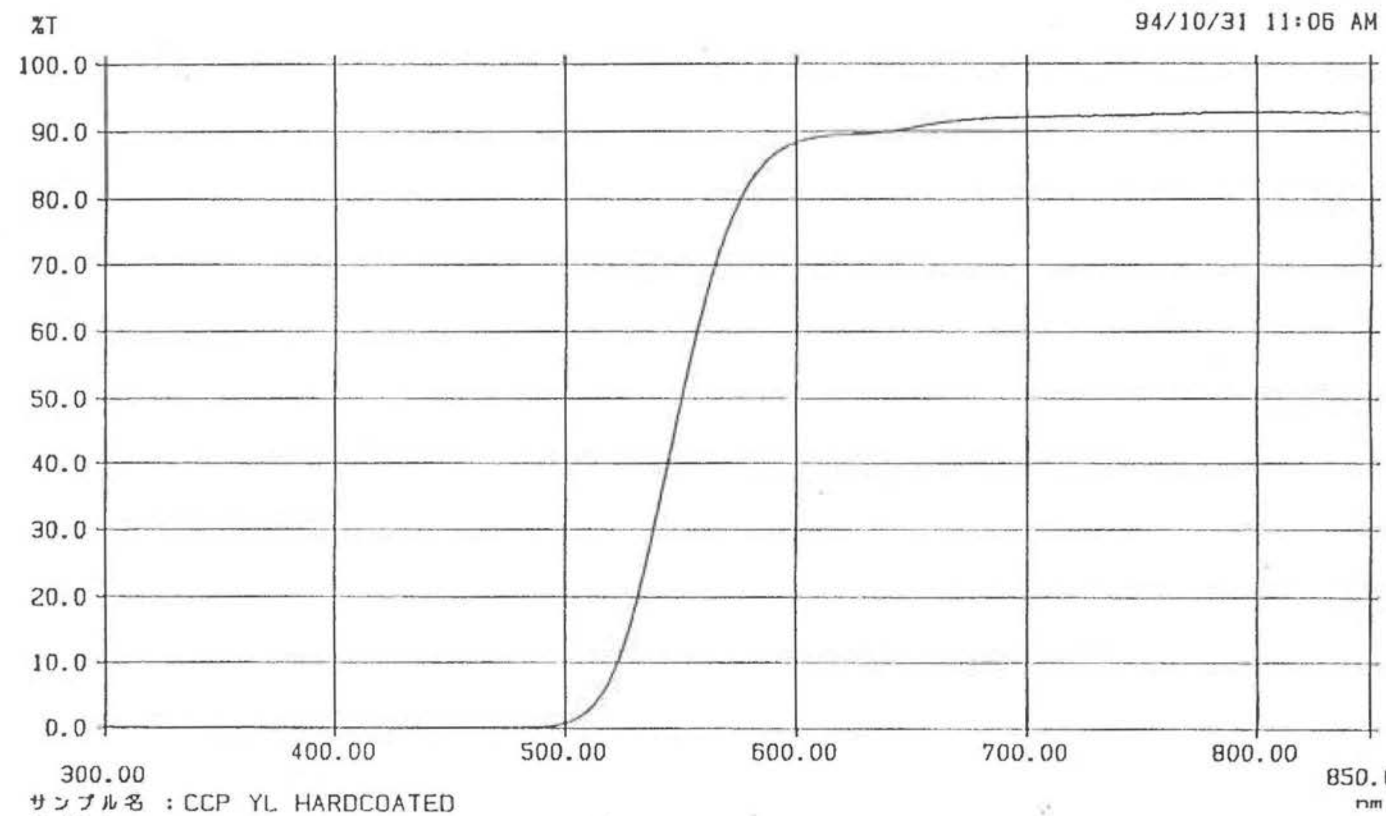
Trace
Mode %T
Ord Max/Min 100.0 0.0
Speed (nm/min) 200
Cycles 1

Operator
SBW (nm) 2.0
WL Max/Min (nm) 800.0 280.0
Time (min/cyc) 2.9

Sample
Smoothing (sec) 1

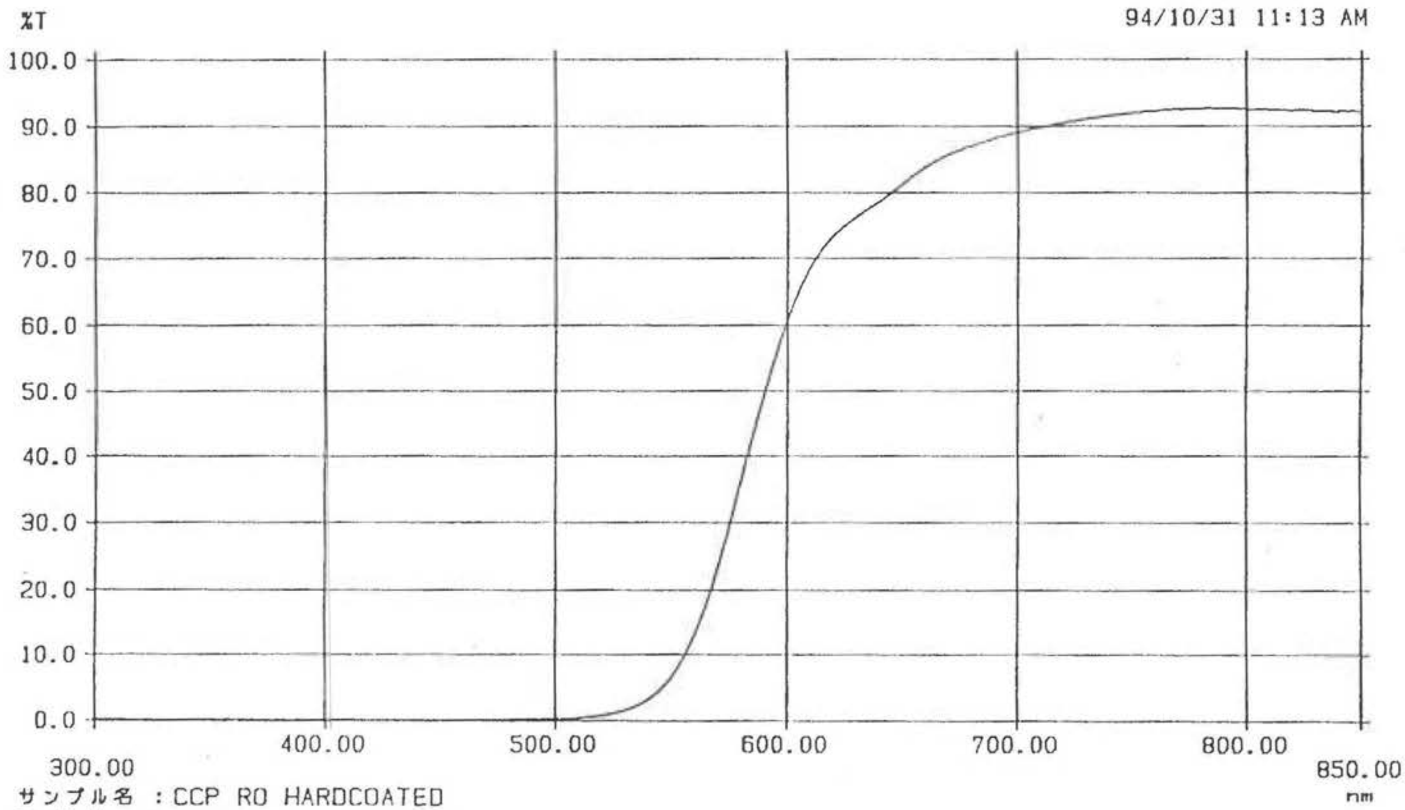


Tokai: Yellow CCP



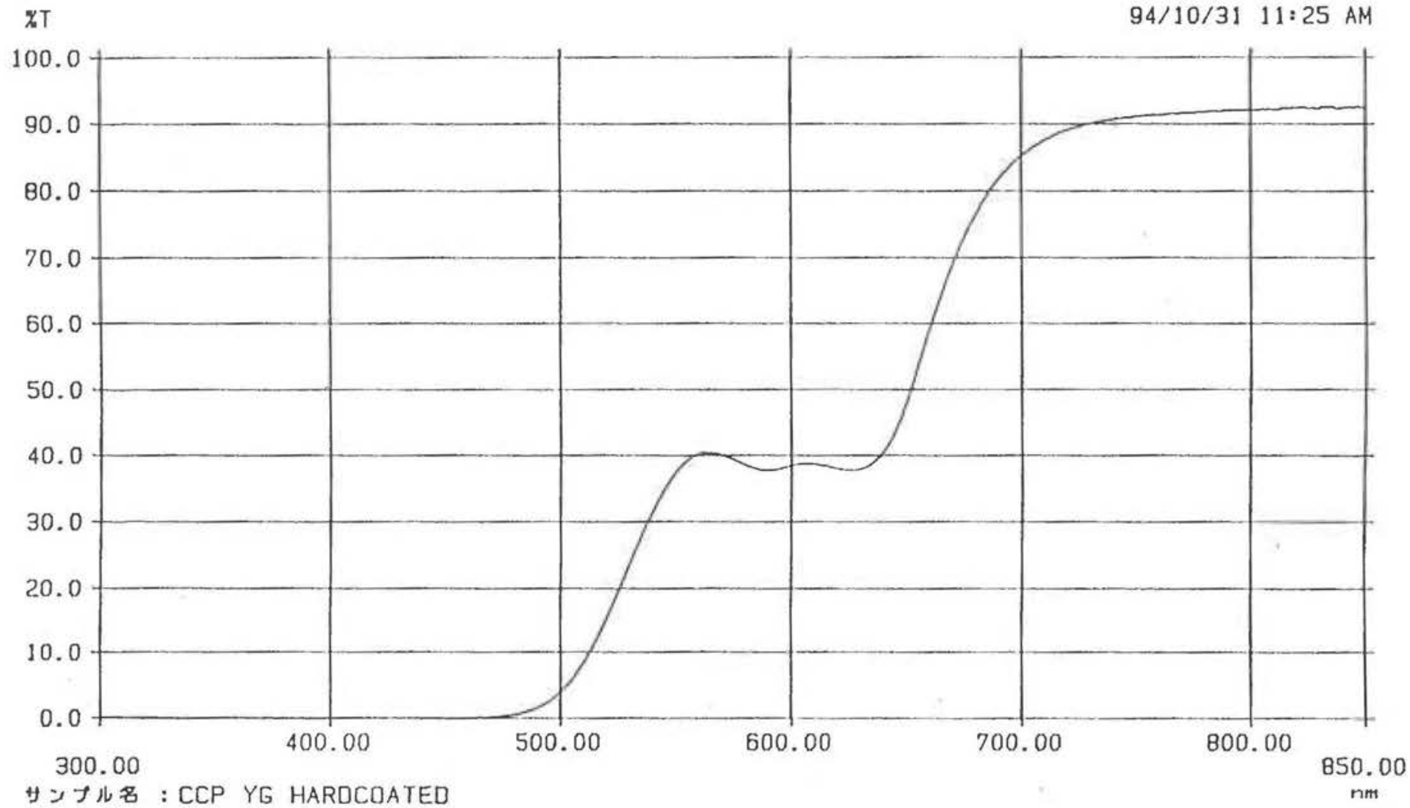
サンプル名　：CCP YL HARDCOATED
コメント　　：
スキャンスピード：300(750) nm/min　　スリット（可視）：6.00 nm
スリット（近赤外）：　自動制御　　ホトマル電圧：　自動制御　　PbS感度：　2

Tokai: Orange CCP



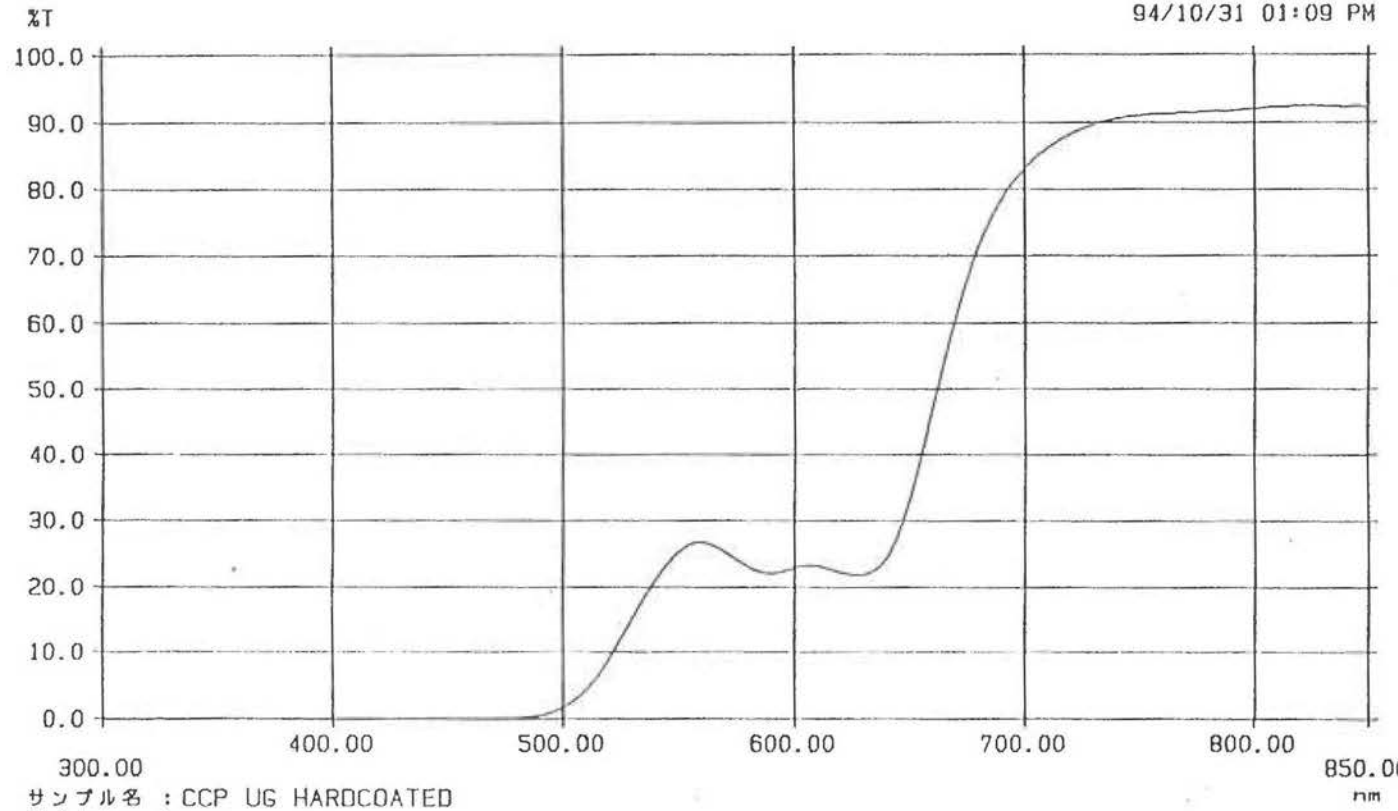
サンプル名 ：CCP RO HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min　スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御　ホトマル電圧： 自動制御　PbS感度： 2

Tokai: Light Green CCP



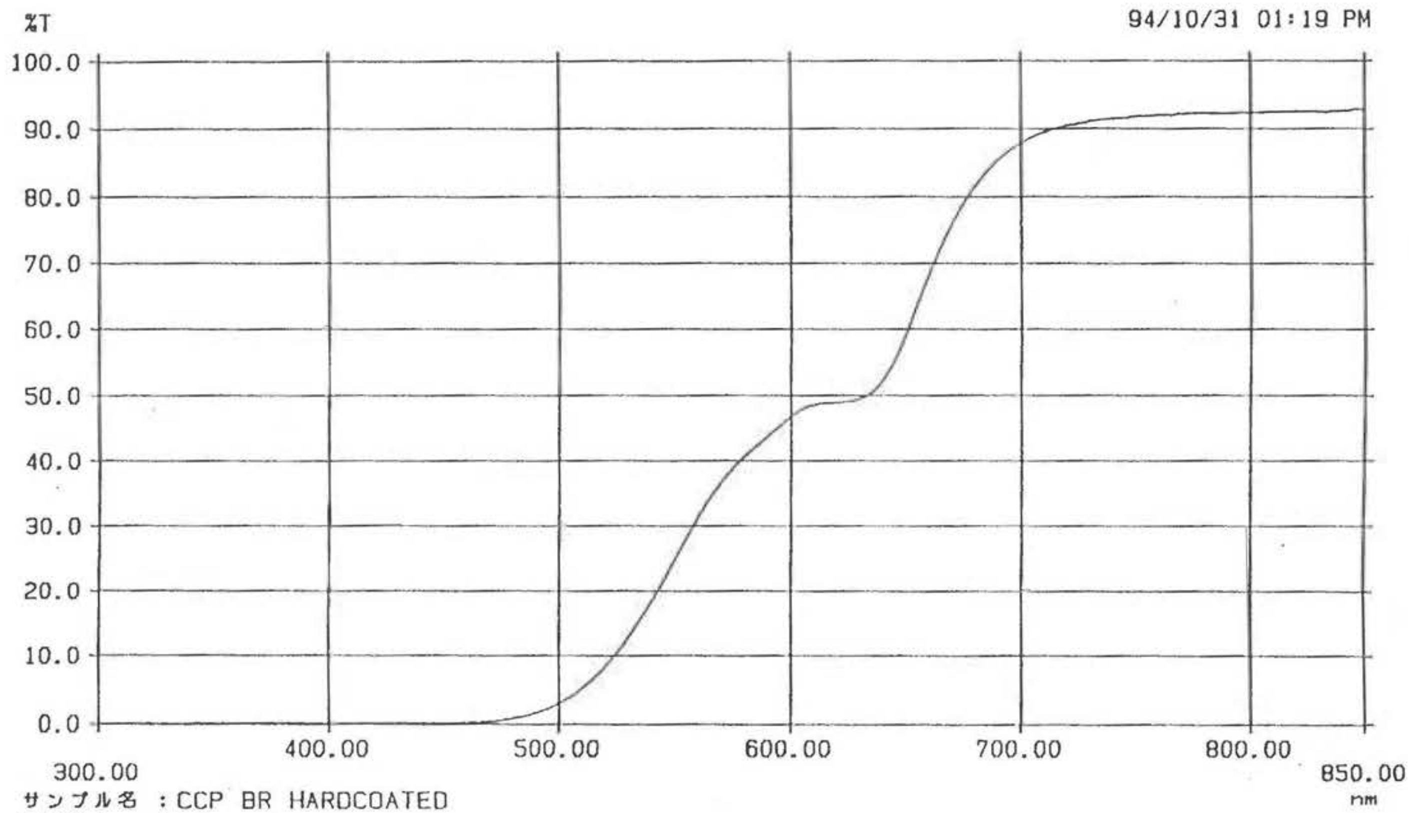
サンプル名 ：CCP YG HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御 ホトマル電圧： 自動制御 PbS感度： 2

Tokai: Dark Green CCP



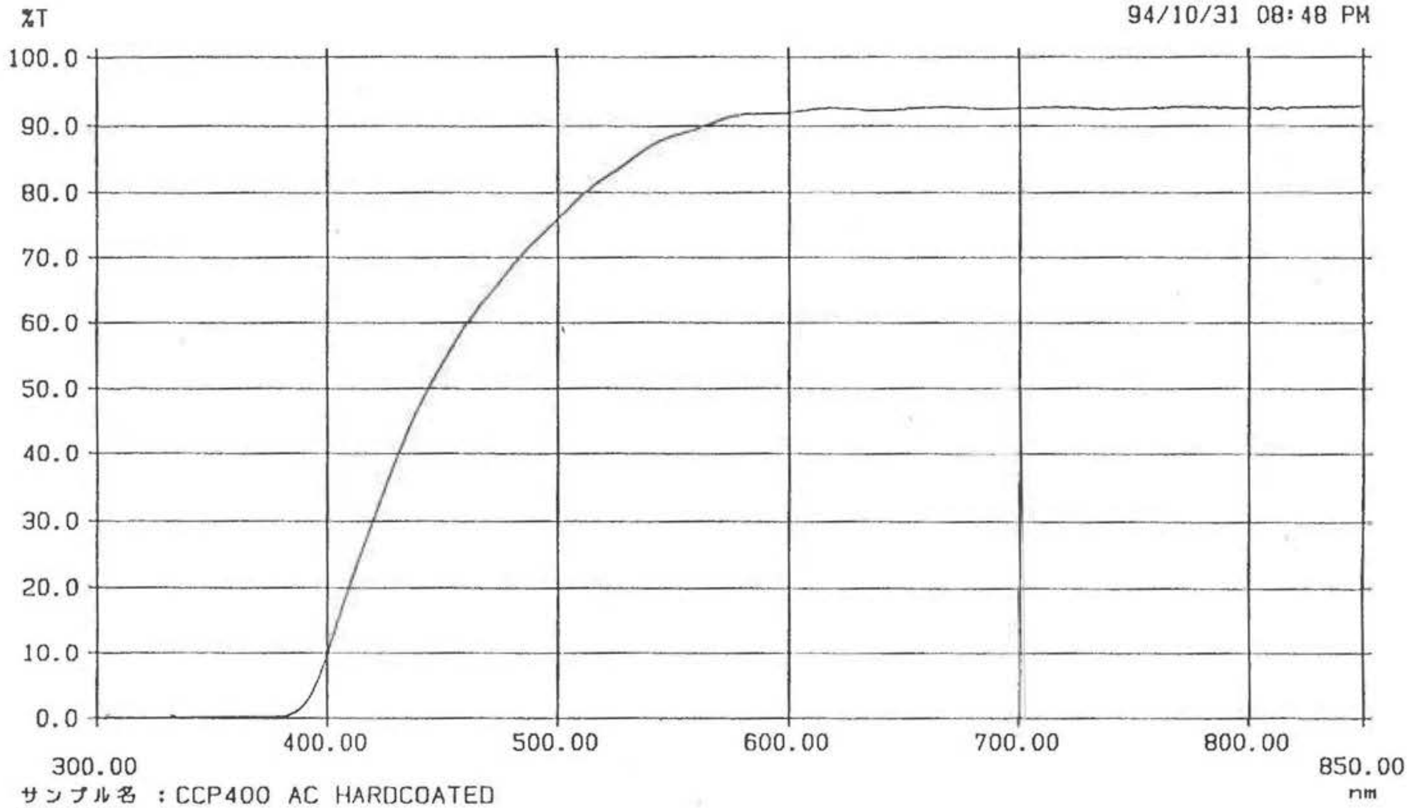
サンプル名 ：CCP UG HARDCOATED
コメント ：
スキャンスピード：600(1500) nm/min　スリット（可視）：6.00 nm
スリット（近赤外）：　自動制御　ホトマル電圧：　自動制御　PbS感度：2

Tokai: Brown CCP



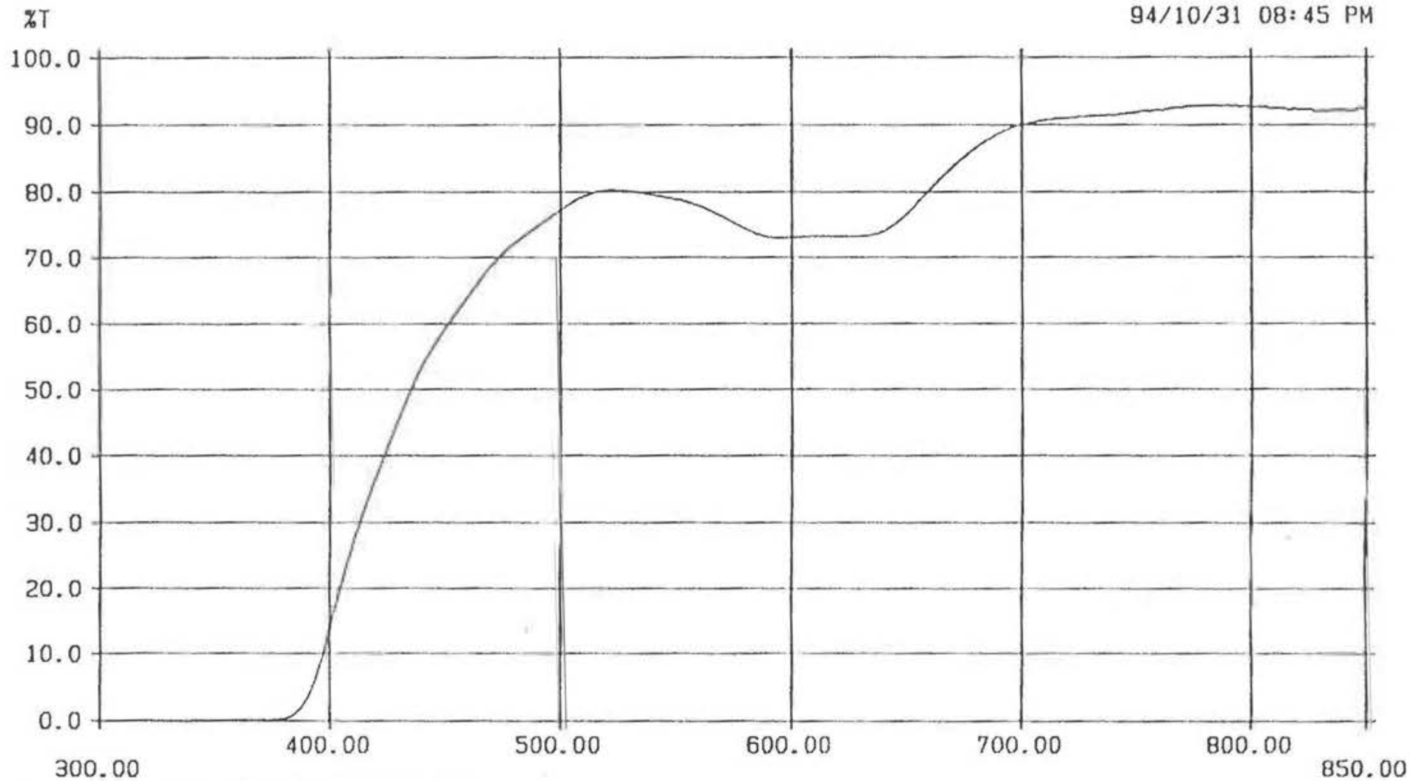
サンプル名 ：CCP BR HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御 ホトマル電圧： 自動制御 PbS感度： 2

Tokai: Amber CCP400



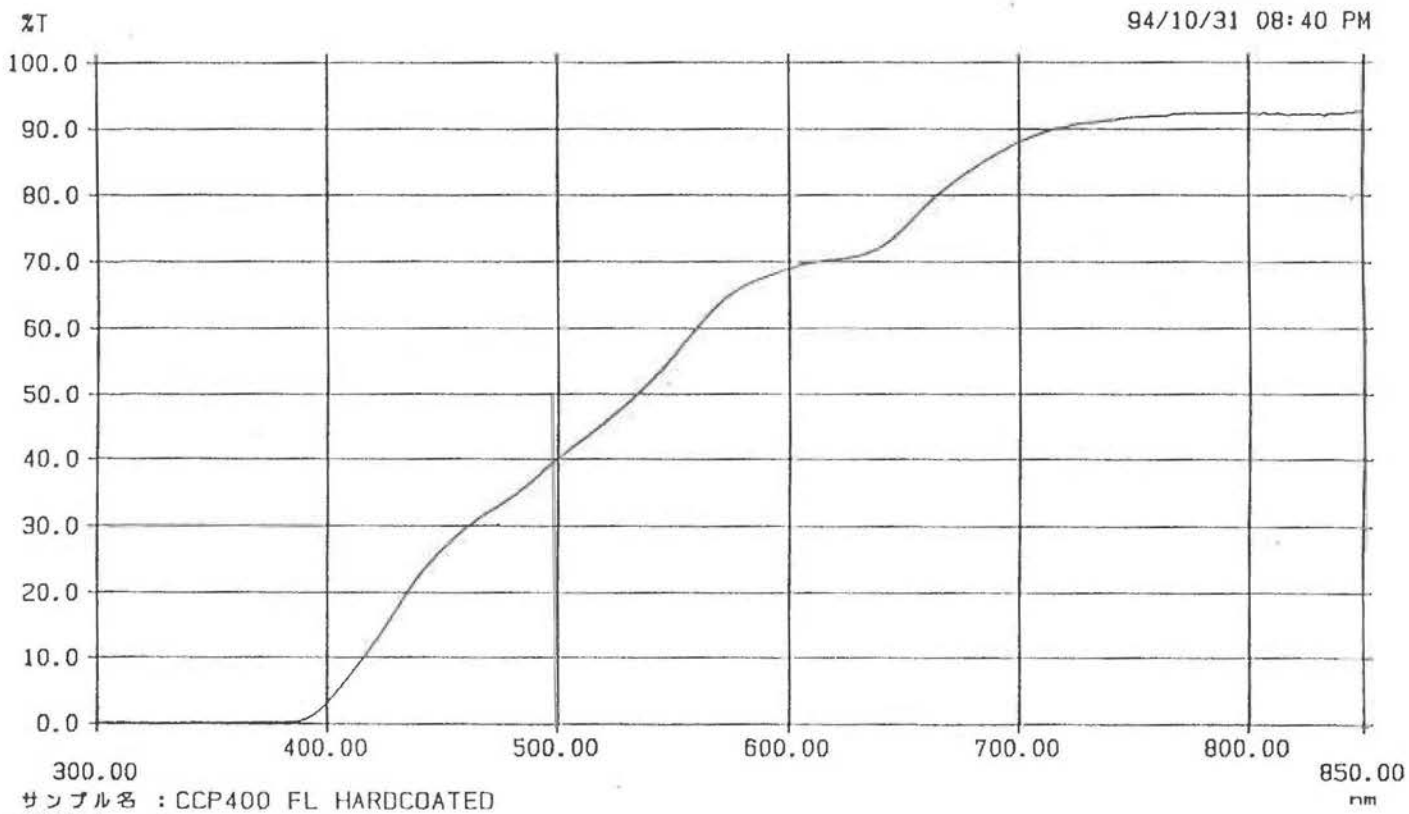
サンプル名 ：CCP400 AC HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御 ホトマル電圧： 自動制御 PbS感度： 2

Tokai: Light Green CCP400



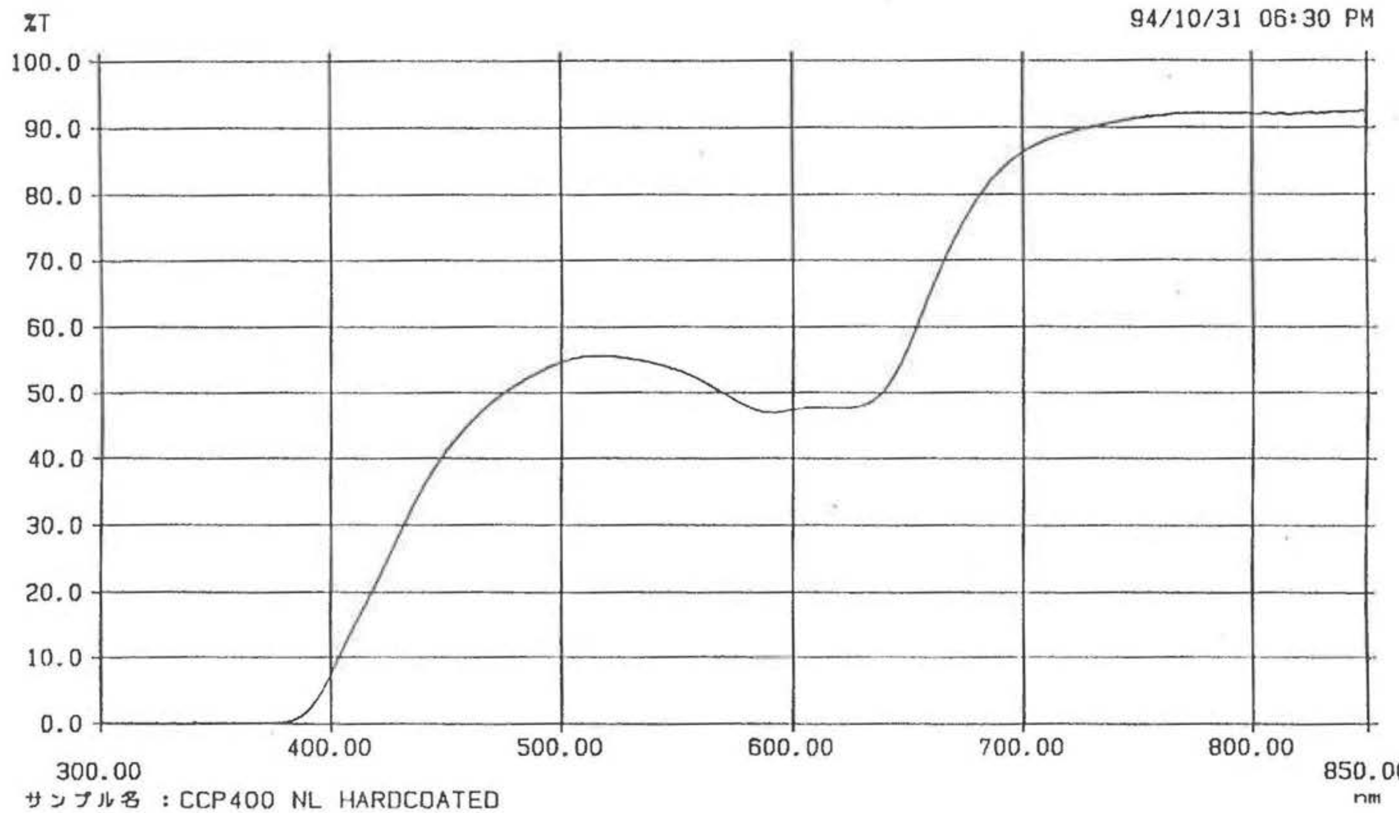
サンプル名 ：CCP400 SC HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御 ホトマル電圧： 自動制御 PbS感度： 2

Tokai: Yellow CCP400



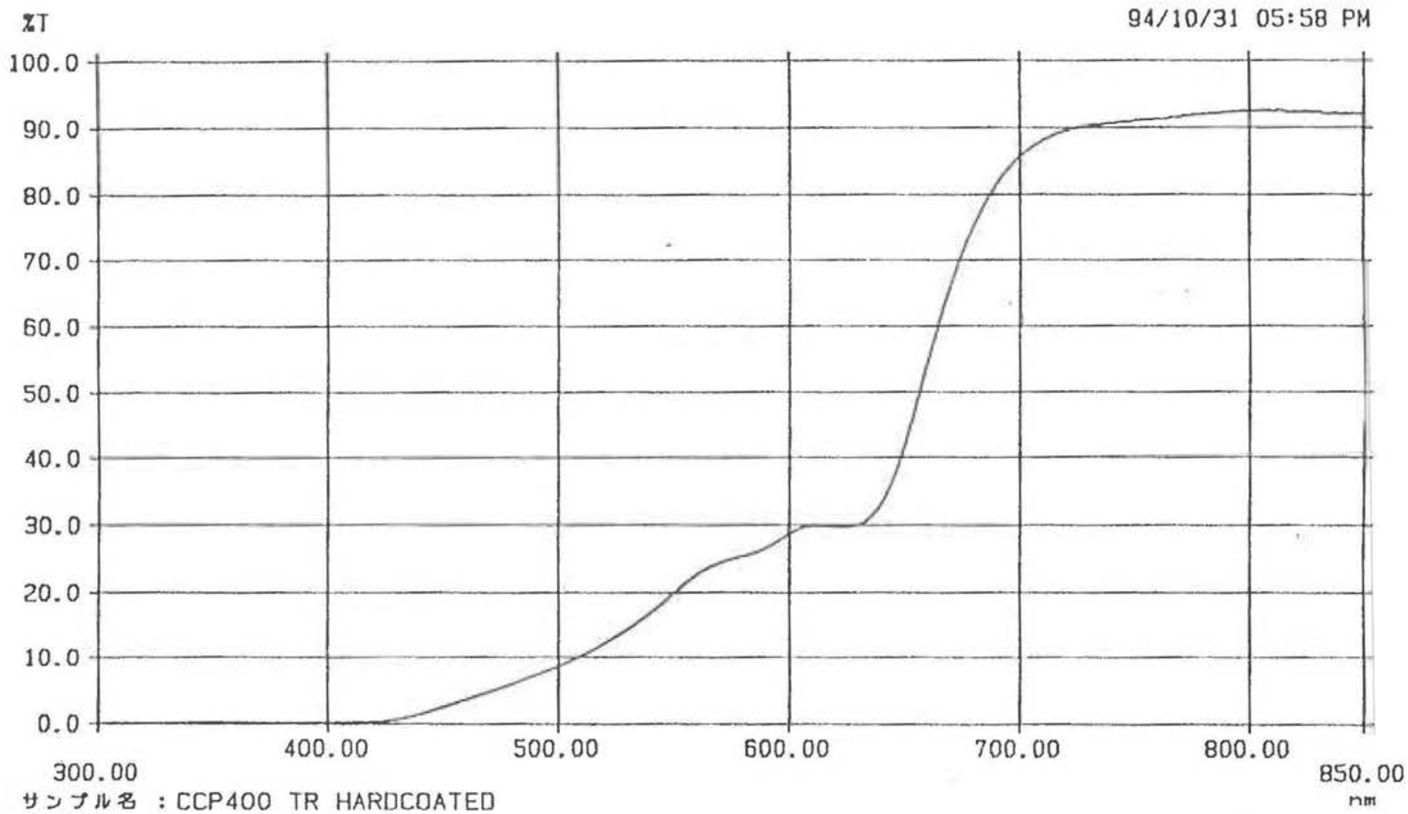
サンプル名 ：CCP400 FL HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御 ホトマル電圧：自動制御 PbS感度：2

Tokai: Green CCP400



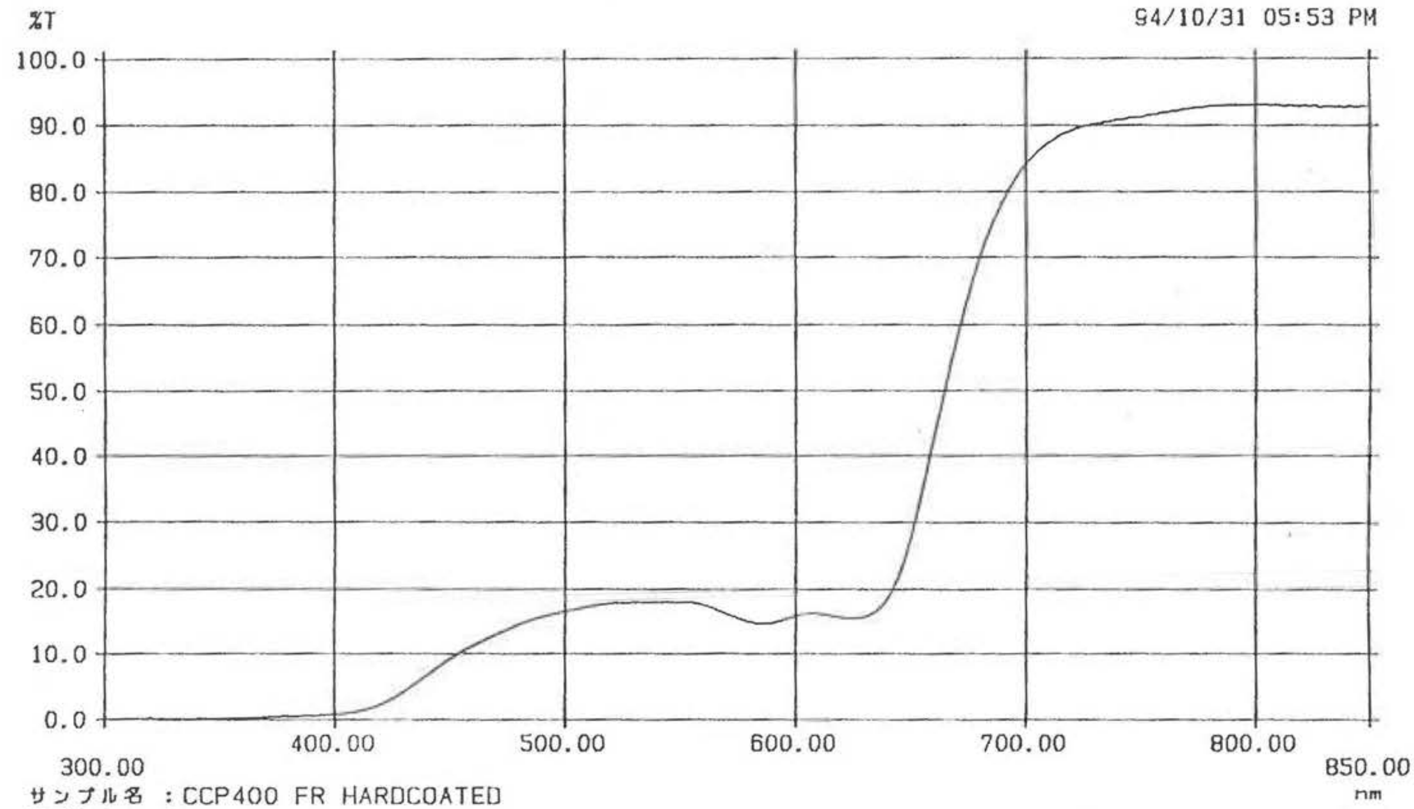
サンプル名 ：CCP400 NL HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御 ホトマル電圧： 自動制御 PbS感度： 2

Tokai: Olive CCP400



サンプル名　：CCP400 TR HARDCOATED
コメント　：
スキャンスピード：300(750) nm/min　スリット（可視）：6.00 nm
スリット（近赤外）：　自動制御　ホトマル電圧：　自動制御　PbS感度：2

Tokai: Evergreen CCP400



サンプル名 ：CCP400 FR HARDCOATED
コメント ：
スキャンスピード：300(750) nm/min スリット（可視）：6.00 nm
スリット（近赤外）： 自動制御 ホトマル電圧： 自動制御 PbS感度： 2

Tokai: Red CCP

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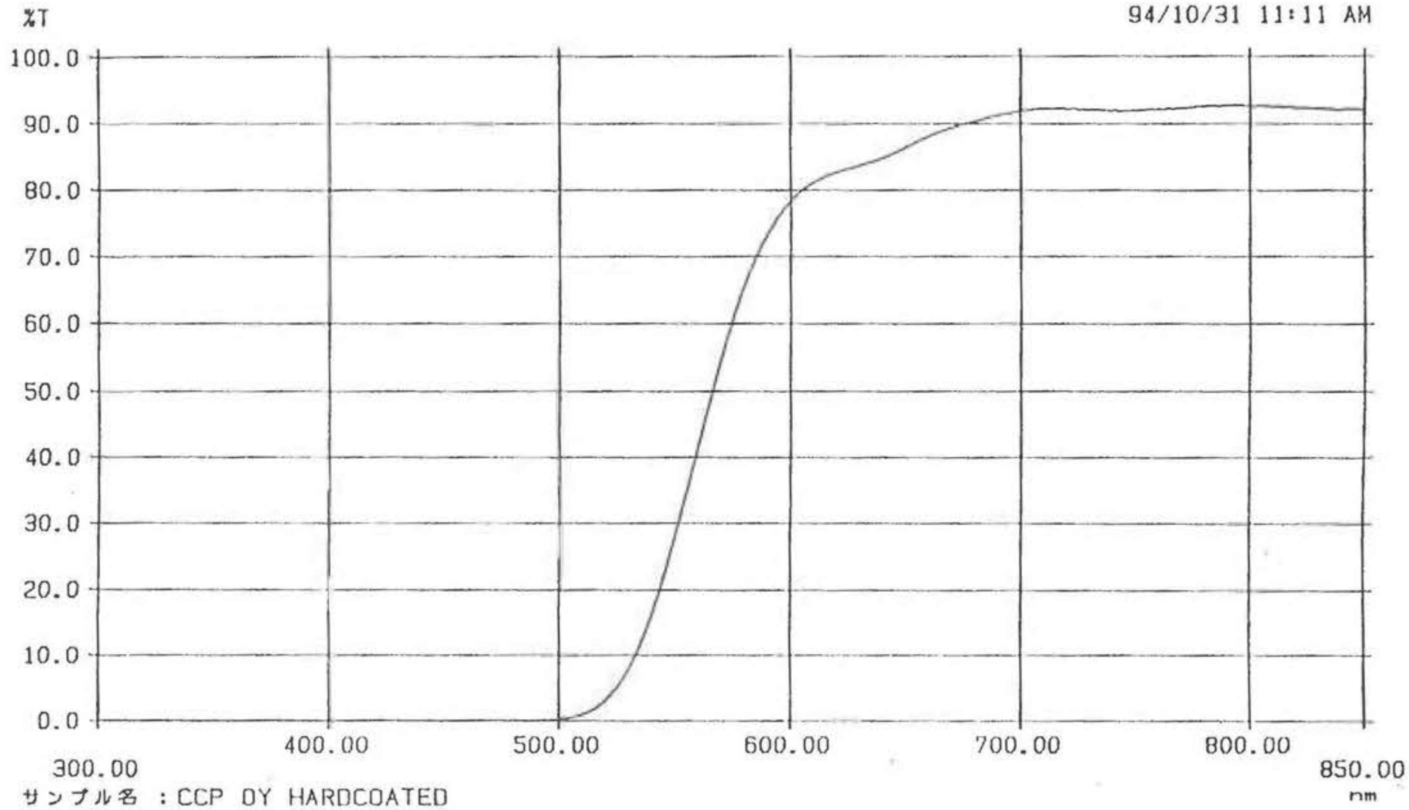

サンプル名 :CCP DY HARDCOATED
コメント :
スキャンスピード：300(750) nm/min スリット(可視)：6.00 nm
スリット(近赤外)： 自動制御 ホトマル電圧： 自動制御 PbS感度： 2